TECHNOLOGY DEPT:

The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

VOL. LV
No. 1435

SATURDAY, DECEMBER 28, 1946

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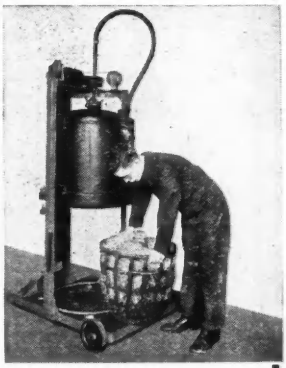

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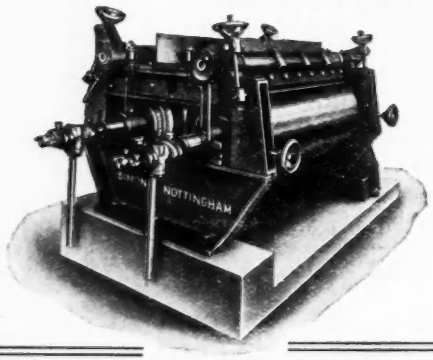

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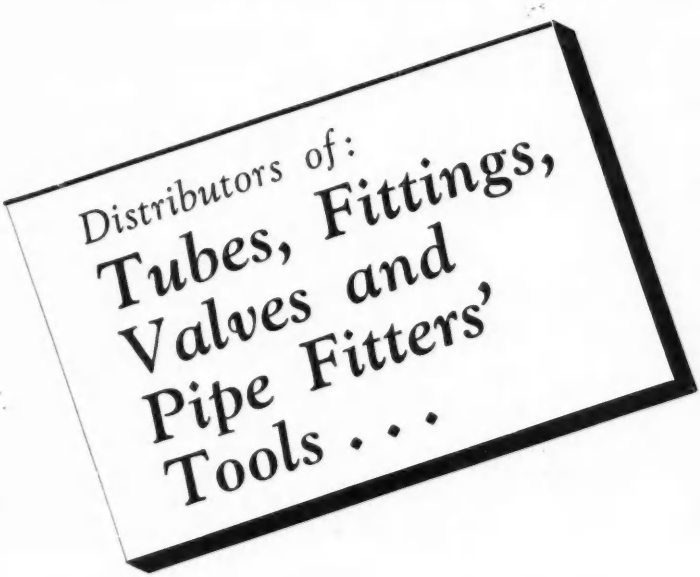

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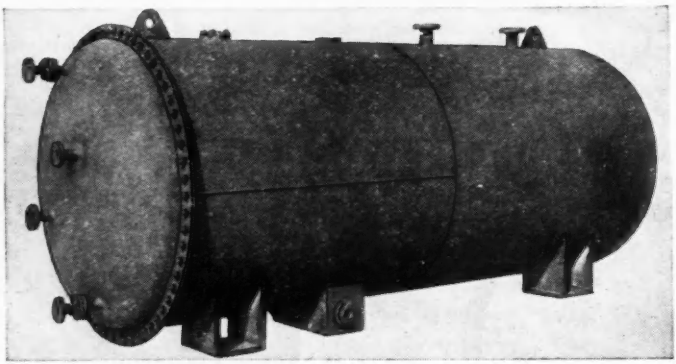

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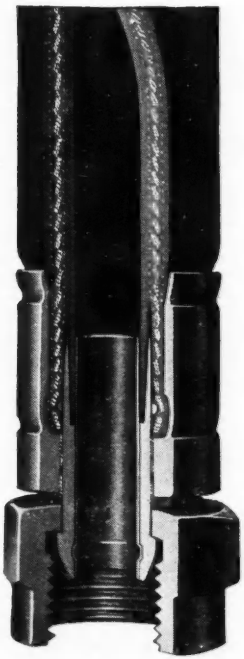

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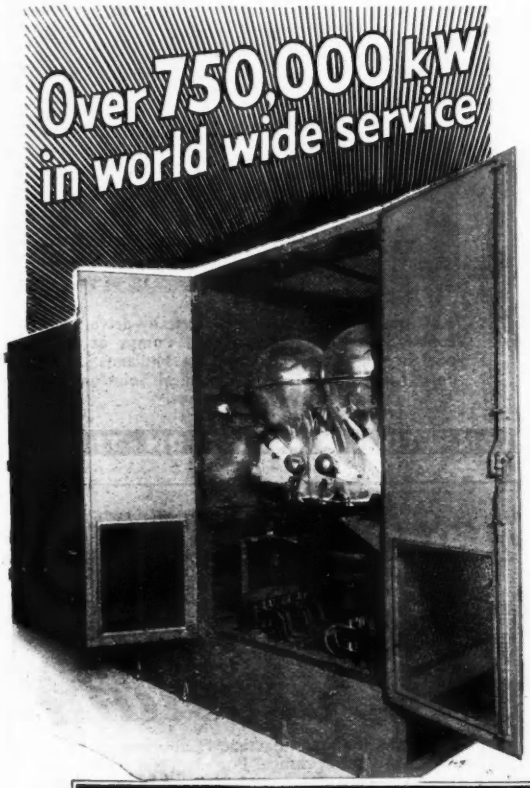

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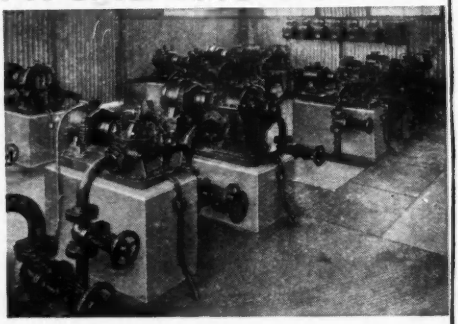

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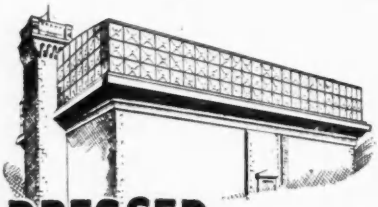

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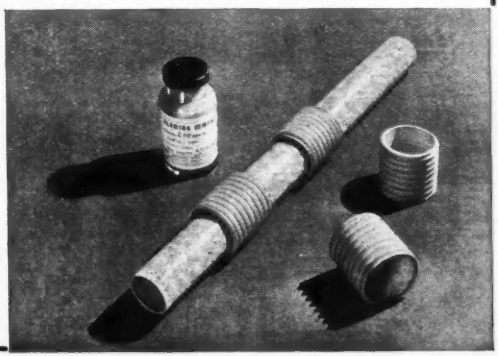

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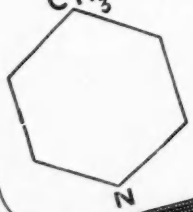

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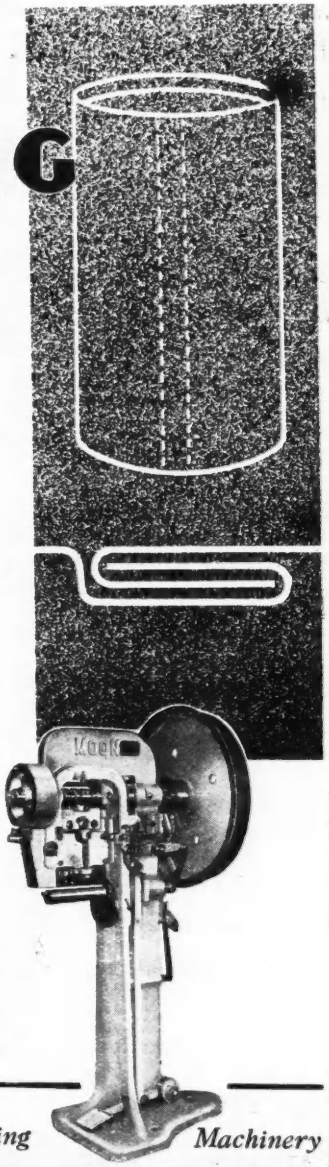

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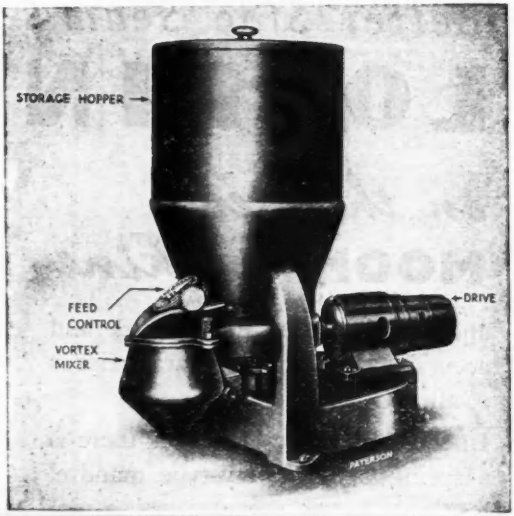

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Coal Hydrogenation

THAT the possibilities of economic production of oil for the internal combustion engine by the Fischer-Tropsch process are remote was indicated in these columns a few weeks ago as the result of a paper by Dr. C. C. Hall to the Institute of Fuel. Another nail was well and truly hammered into the synthetic oil coffin as the result of a paper by Mr. Kenneth Gordon on December 9 to the same body (*see* THE CHEMICAL AGE, Dec. 21, pp. 761-770, and pp. 795-804 of this issue). Mr. Gordon, having been largely responsible for the working of the hydrogenation plant at Billingham, speaks with authority. To be sure, his paper contains no direct appraisement of the economics of the process. It might even appear from the account of the brilliant work done at Billingham that the process is still very much alive. But the paper left in the minds of many the feeling that the days of coal hydrogenation are numbered—at least for many years to come—and this feeling was expressed in the debate by many of those who took part.

The achievements of those who designed, operated and directed the process of coal hydrogenation in this country during the war were striking. The process was not only operated to capacity in spite of adverse conditions, but extended to include products not thought of as commercial possibilities when the hydrogenation process was first devised by Bergius. The rising price of coal has compelled the operators to use oil as the raw material. That change was dictated for economic reasons, but also arose because of the time taken to close down a coal-hydrogenation unit when an air-raid was in progress. The overall thermal efficiency of the oil-hydrogenation process is much greater than that of the coal-hydrogenation process.

One of the earliest improvements made during the war was the use of the methane-steam process for the manufacture of hydrogen. Considerable quantities of methane are produced during hydrogenation and some 17 per cent by weight of total hydrocarbon gases are given by the author as derived from the processing of a ton of creosote oil. Methane treated with steam in the presence of a nickel catalyst gives almost complete conversion to hydrogen and carbon monoxide. Passage over a second catalyst, consisting of iron-chromium, enables the CO in this gas to be used for the production of further supplies of hydrogen. This method is of great interest to the oil industry and was also incorporated in a second hydrogenation plant that was erected at Heysham.

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The Heysham plant incorporated many improvements that had been discovered as the result of the work at Billingham.

There has been a progressive increase in the volatility of the oils produced both at Billingham and at Heysham as compared with the earlier Billingham practice. The oils were sold through the normal petrol distribution channels and thus from the beginning had to be in line with the specifications of the petroleum companies. Before the war petrol was made of commercial grade, No. 1 premium, both straight and leaded, and also 87 octane number aviation fuel. During the war at both plants, the manufacture of 87 octane number aviation spirit was continued, but in addition there were produced pool petrol and base spirit for the manufacture of 100 octane petrol. A goodly portion of the more volatile hydrocarbons produced consisted of butane. This was dehydrogenated to butenes, followed by polymerisation and hydrogenation to iso-octane.

It had been decided early in 1939 to install plant for the production of 10,000 tons a year of iso-octane and this plant went into operation in October, 1940. From May, 1942, the manufacture of 87 octane number petrol was discontinued and the sole output of the Billingham plant was 100 octane aviation components. From 1942 the Billingham plant was run in conjunction with the Heysham plant, which worked on gas oil, not on creosote, and with the Shell Company's iso-octane plant at Stanlow, the object being to produce the maximum quantity of aviation spirit. A further change was made in 1944 when one of the Billingham hydrogenation units was converted to the manufacture of butyl benzene, also used as an aviation spirit component. This was made by alkylation of benzene with the butylenes obtained from the iso-octane units, so that its manufacture was alternate to that of iso-octane. Butane, of course, can be sold as bottled gas and large quantities were sold for this purpose. A propane recovery plant was also added, the propane being used as a substitute for acetylene for metal cutting. Finally, it may be noted that the hydrogenation product contains considerable quantities of phenols and as long ago as 1937 a plant was installed for the production of phenol and cresols; if means could be devised for greatly increasing the yield of these compounds, a step of considerable importance would be taken towards rendering the hydrogenation process economic.

This is a brief resume of some of the more important steps that have been taken. The process has been improved by the discovery of new catalysts and this account would be incomplete if some mention were not made of the very valuable work done in this connection. Thus for vapour-phase hydrogenation, the preferred catalyst up to 1935 appeared to be a mixture containing zinc oxide, magnesium oxide and molybdenum oxide. A big step forward was the discovery by the I.G. of tungsten sulphide and this is still used for some purposes. A further step forward was made in 1935 when the value was discovered of a mixed catalyst composed of 10 per cent tungsten sulphide supported on alkaline earth. Finally, the most important discovery appears to have been that of new catalysts for the second stage of the two-stage vapour-phase method in which the tungsten was replaced by iron. A very ingenious method was worked out for controllng the temperature of the vapour-phase method—a most necessary condition of successful operation—in which the convertor was divided into numerous sections and between each two sections the vapours could be mixed with cold gas and re-distributed over the next batch of catalysts.

This discursive and incomplete recital of some of the more important developments has been given with a purpose. That purpose is to indicate the immense amount of hard research, chemical engineering skill, and expenditure of human effort and material resources that have been put into the hydrogenaton process. Whether the process is continued or not—and we feel it highly probable that the hydrogenation of creosote and of gas oil will continue—that skill and effort has not been wasted. It has given to this country the "know-how" which no amount of theoretical study could possibly have done. Mr. Gordon confirmed this view, and said that much of the technique used in this group of processes had been of inestimable value in other I.C.I. processes. There is a sense in which fundamental work in chemical engineering can be just as valuable and just as necessary as fundamental work in science. This is an outstanding example of the truth of that principle. It would be a bad day for the country if such fundamental work were discontinued; but there appears to be only the one company that can hope to do such work on a sufficiently comprehensive scale.

The hydrogenation work was engendered by war; its need may have passed with the conclusion of the second German war; we hope it has, but an immense amount of good must remain.

It is a curious fact that any process that is devised for the chemical utilisation of coal or coal products appears to be applicable immediately and mainly to the petroleum industry. The pipe still for oil distillation was devised originally for coal tar, but was applied primarily to the oil industry until in the past 10 or 15 years it has been again used largely for the distillation of coal tar. Diesel introduced his engine with the intention of using it for coal dust, but found its application lay in the utilisation of heavier petroleum oils. The Fischer-Tropsch process has been developed for use with reaction gas mixtures made from coal, coke or coal gas, but these sources of synthesis have now proved too costly, and the cheapest synthesis gas is provided by the methane derived from natural gas through the steam-methane reaction. Now also, hydrogenation, originally designed to deal with coal, seems likely to be used primarily in the oil industry as a means of dealing with heavy oils. Will fuel oil in future be hydrogenated, so that no fuel oil will be available for burning purposes? It is greatly to be hoped that means will be found to enable the various processes devised as a result of the work of the past 20 years to be continued with creosote oil as their raw material. The proper use of creosote oil is surely not to burn it as such, but to convert it into a series of high-value products, aviation spirit, iso-octane, butyl benzene and so forth. We trust that this great work will not be found to have ended in the " glorious failure " predicted by so many of those who took part in the debate at the meeting of the Institute of Fuel. Whatever may be the ultimate outcome, something of very great value has resulted from what has here been done.

NOTES AND COMMENTS

B.A.C. STATEMENT OF POLICY

THE statement of policy issued by Mr. Norman Sheldon on his election as president of the British Association of Chemists, will, we think, be welcomed by most members of the association. This forthright announcement of the association's aims and policy, and the rigid refusal to be associated with any political party, will clear the air and perhaps induce chemists to take a greater interest in their organisation. The B.A.C., Mr. Sheldon pointed out, is registered as a trade union so that its functions may be performed more efficiently, but that it does not mean political affiliation with any party. Although political association of the B.A.C. as a whole is eschewed, individual political liberty is encouraged in fact, members of the association may receive financial backing if they feel called upon to play their part in the field of public affairs, no matter to what party they chose to belong. In addition to this the news that the association is exploring the possibility of starting up a superannuation scheme which will be transferable from one firm to another, is a further welcome indication of enlightened progress.

FENCING DANGEROUS MACHINERY

THE very wide extent of the duty to fence dangerous machinery was illustrated by the successful claim of a workman in the High Court. He was injured in rather unusual circumstances. A piece of a neighbouring machine broke away, flew out of its holder and struck and injured him. The man who was operating the machine was uninjured. The machine which broke had the usual type of guard, but it was proved that it would have been possible to provide a better guard which would probably have prevented the injury. The workman's claim succeeded on the ground that the employers had been guilty of a breach of the statutory duty which they owed under the Factories Acts—" every dangerous part of any machinery shall be securely fenced " and under special regulations affecting this particular machine " the cutter of every vertical spindle moulding machine shall when practicable be provided with the most efficient guard having regard to the nature of the work to be performed." The employers set up the argument that the special regulations were intended for the protection of the worker at the machine only.

Mr. Justice Hilbery rejected this argument, while admitting that the primary purpose of the regulations was the protection of the operator. He held that on the facts the most efficient guard had not been fitted and that the injured worker was therefore entitled to damages.

LOST PRODUCTIVITY

A REPORT from the U.S. Bureau of Labour Statistics gives figures which show that over a long period worker productivity in the U.S. has doubled every twenty years. Even in the years 1939 to 1945 worker productivity in 32 industries rose 6.6 per cent. It is expected that when the major industries, such as the motor-car industry, are fully re-converted, output figures will continue to show a rapid rise in the years to come. Worker productivity, however, the report says, is not measured solely on the energy or efficiency of the worker. The skill of the management, the efficiency of the tools provided for the workers, and the over-all rate of production at which the industry is performing are equally important factors. It adds that productivity can be measured in advance by the amount of money spent by industry in providing new and better machinery. The U.S. Government apparently believes that labour productivity is due to rise unusually rapidly in the future as more and more industries are re-opening and getting into full production. This picture from the U.S. is in striking contrast with the sombre colours of the British scene. Many prominent people in this country, including Cabinet Ministers, have repeatedly called attention to the decreased productivity over here. The latest warning comes from Sir Claude D. Gibb, president of the North-Eastern Section of the Institute of Production Engineers. At Newcastle on December 12 he said that output per man hour to-day was lower than it was before 1939 and much lower than during the war. The reasons given, said Sir Claude, varied according to one's political, economical or medical outlook. Although much was said of the lost incentive of the workers, no mention was made of the lost incentive in management, of the manager suffering from malnutrition, or being "fed up" with high taxation. Nothing, he said, would be more dangerous than management fatigue. Although management fatigue does not figure in the American report, nor ways of dealing with it, we can visualise some easy cures for this complaint. Coincident with management fatigue is machine fatigue, the only remedy for which is the provision of more and better machinery to give greater productivity. Sir Claude Gibb claimed that horsepower must be made the servant of each producer by building more machines, tools and mechanisms which would produce more articles per hour per man employed than hitherto. With this view we are in accord. If our productive power is declining we must make and use tools which will take over and thus save valuable manpower.

ALICE'S LOOKING GLASS

A TRANSPARENT mirror, many of which are now being manufactured in the U.S., is an apparent contradiction in terms. But this mirror simultaneously acts as a reflecting surface when viewed on one side and as a window from the other. This peculiar performance is due to a thin film of chromium alloy, four ten-millionths of an inch thick, with which the glass is mirrored, so that while acting as an effective reflector it also permits passage of light. This is a wartime discovery now being put to a peacetime use. Cinema fans will remember this type of mirror was used in a spy film, "The House on 92nd Street," where G-men were able to take photographs of the spy headquarters through a bath room cabinet fitted with such a transparent mirror. There are many uses to which this mirror can be put, *e.g.*, in doors or windows of houses so as to permit of the occupants examining any caller without revealing their own presence. Among other applications are observation windows in clinics and in television production and advertising displays.

Fire Protection

The under-lying principles of fire protection in buildings are reviewed in a report just published, "Post-War Building Studies No. 20—Fire Grading of Buildings" (H.M. Stationery Office, Kingsway, London, W.C.2, 1s. 6d.). The report is the work of a joint committee of the Building Research Board, the Department of Scientific and Industrial Research and the Fire Offices' Committee, and is published for the Ministry of Works.

PROGRESS IN HYDROGENATION OF COAL AND TAR*

by KENNETH GORDON, C.B.E., M.C.

In vapour-phase hydrogenation the vaporised oil mixed with hydrogen is passed over a solid catalyst. The boiling range of the oil that can be treated is determined by the ratio of gas to oil, and in practice we find that an end point of 330° C. is the upper limit. Good fractionation with sharp cutting is necessary. Oils from petroleum, oils made by the hydrogenation of coal or tar, and oils obtained by distillation from both high-temperature and low-temperature tar are equally suitable for the process. The greater the amount of hydrogen to be added, the greater is the heat evolved and the greater the amount of attention that has to be paid to the arrangements for controlling temperatures.

TABLE VIII.

OPERATING CONDITIONS AND YIELDS FOR LIQUID-PHASE HYDROGENATION OF CREOSOTE HEAVY OIL.

Operating conditions

(These relate to a 2-converter stall of 18.8 m³ reaction volume).

Catalysts	CC1⁴	0.01 to 0.04 per cent. on cold feed.
	Iodine	0.02 per cent. on cold feed.
	Tin oxalate	0.01 per cent. on cold feed.
Creosote HO consumption rate		...5.3 tons/hour ; 0.28 tons/m³ reaction volume/hour.
Total cold feed rate	...	... 11 to 14 tons/hour.
Hot recycle heavy oil	...	... 10 tons/hour.
Inlet gas ...	...	... 13,500 m³/hour.
Cooling gas	...	... 6,500 to 11,000 m³/hour.
Preheater exit temperature		... 420 to 430° C.
Temperature in first converter		... 445 to 475° C.
Temperature in second converter		460 to 475° C.
Inlet pressure	...	... 246 atmospheres.
Inlet hydrogen partial pressure		... 200 atmospheres.

Overall yields (weight per cent. of creosote heavy oil treated) :

	Per cent.
Refined petrol, 170° C. F.B.P.	11.2
Middle oil, 170° C. to 320° C.	... 70.7
Liquor	... 2.0
Hydrocarbon gas ...	... 17.0
Loss	... 3.8
Hydrogen used	... 4.7

In the information published up to 1935, the preferred catalyst appeared to be a mixture containing activated molybdenum oxide, a typical analysis being :

Zinc oxide	31 per cent
Magnesium oxide	15 per cent
Molybdenum oxide	54 per cent

Such catalysts work at relatively high temperatures, and give relatively low yields with high gas formation. A big step forward was made in 1930, when the IG discovered the suitability of pure tungsten sulphide, WS_2 (5058) as a hydrogenation catalyst. This catalyst is extremely active both from the point of view of hydrogenation and for splitting. It is equally suitable for any type of feed stock. It is necessary to ensure a minimum concentration of sulphur, either in the oil or in the hydrogen, in order to maintain continuous catalyst activity, and this concentration depends on the composition of the oil. The natural sulphur content of oils is generally enough except in cases where the feedstock is abnormally low in that element, as is generally the case if the oil is itself a hydrogenation product. The sulphur can either be added as elemental sulphur or as H_2S. The latter is preferred, and the H_2S can be recovered from the gases leaving the plant and recycled.

Important Advances

The tungsten sulphide catalyst was a big step forward from the point of view of yield, and it needed a lower temperature for operation. The product had a better boiling range than that from the earlier catalysts, which were apt to give material deficient in light boiling compounds, because of the very largely aromatic nature of the product. On the other hand, the low aromatic content of 5058 petrol was responsible for it having a comparatively low knock rating (68 to 70), and it tended in the mid-1930's to become inadequate for market requirements.

A timely further step forward was made in 1935 by the discovery of a mixed catalyst, composed of 10 per cent tungsten sulphide supported on activated earth (6434). This catalyst gave very similar results, so far as yields were concerned, as the pure tungsten sulphide, but the product had a greatly improved knock rating. This new catalyst could be used directly for some petroleum oils, but lost its activity quickly if coal or tar oils were used without pretreatment. Such materials need a preliminary hydrogenation before they can pass to the new catalyst. Catalyst 5058 is very suitable for this first stage.

A decisive, although probably not the only, factor is the nitrogen content of the oil, and it is found in practice that the nitrogen content must be maintained below 5 parts per million for the catalyst activity in the second stage to remain at a high figure. Circulating hydrogen must also be

* Continued from *The Chemical Age*, December 21, 1946 (*see* pp. 761-70).

freed from ammonia by water washing. Under these two-stage conditions, the temperature required for satisfactory splitting hydrogenation over 6434 is lower than is necessary in the single-stage 5058 process.

The preliminary nitrogen removal over 5058 catalyst inevitably results in the production of a certain amount of petrol, for example, by conversion of phenols to cyclohexanes, and aromatics to lighter boiling naphthalenes. At Billingham we have kept this petrol production to a minimum by careful attention to the design of the converter internals to ensure accurate temperature regulation. It has consequently been unnecessary to distil petrol from the crude "saturation stage" product before subjecting it to the second stage treatment. The final total petrol has not been appreciably inferior in knock rating to that which could have been made in the second stage from saturated middle oil alone. In Germany, the same success in minimising splitting in the saturation stage was not achieved, and the crude product frequently contained about 50 per cent of petrol with a relatively low knock rating. It was therefore customary to distil off petrol from the crude saturation product, and so treat only the middle oil in the second step.

An advantage of this two-stage process is that by controlling the amount of hydrogen added at the first, or saturation stage, it is possible to control the knock rating of the product of the second stage. The more hydrogen is added at the first stage, the lower the knock rating of the product from the second stage. The limit of this flexibility is the minimum hydrogenation necessary in the first stage to ensure absence of nitrogen.

The use of this two-stage process enabled the Billingham blend to meet the No. 1 Grade Specification for motor fuel in force up to the outbreak of the war, which demanded an octane number of 75, as determined by the CFR Motor Method. Still further improvements in specification were contemplated at that time which led us to give attention to catalysts to give still further improved results. Success was achieved with new catalysts for the second stage of the two-stage process in which the very active hydrogenating component tungsten sulphide was replaced by less active elements. In the preferred catalyst the tungsten was replaced by iron. The catalyst (231) enabled motor fuel with a clear octane number of 78 to 80 to be made. Its greatest importance was for the manufacture of aviation fuel. This advance, which was worked out entirely at Billingham, was a step of equal importance to the others which have been described.

Table V shows a comparison of the operation of these vapour-phase hydrogenation catalysts. Four examples are given:

(a) The single-stage operation with tung-

TABLE IX.

TYPICAL FULL-SCALE OPERATING CONDITIONS AND YIELDS FOR VAPOUR-PHASE HYDROGENATION OF CREOSOTE MIDDLE OIL.

Process	(*a*) Single stage petrol production	(*b*) Saturation stage 2-stage process	(*c*) Splitting stage 2-stage process	(*d*) Splitting stage 2-stage process
Catalyst	5058	5058	6434	231
Petrol made	Premium grade motor spirit 45 per cent. vol. at 100° C.	Feed for (*c*) and (*d*)	Premium grade motor spirit 45 per cent. vol. at 100° C.	Base spirit for 100 octane fuel 72 per cent. vol. at 100° C.
Make-up feed rate, tons/m³ catalyst hour	0.59	1.2	0.85	0.55
Total oil feed rate to hydrogenation stall, tons/m³ catalyst hour	1.1	1.2	1.3	1.0
Vaporising gas rate, m³/ton total oil fed	2000	2800	1600	1700
Cooling gas rate, m³/ton total oil fed ...	1700	1900	900	850
Vol. per cent. hydrogen in inlet gas ...	85	87	83	86.5
Vol. per cent. hydrogen in exit gas ...	82.5	85	80	85.8
Total pressure inlet converter, atmospheres	256	256	256	256
Total pressure exit converter, atmospheres	249	249	249	249
Average reaction temperature °C. (with medium age catalyst)	420	385	400	370
Pass conversion of middle oil	54%	100%	65%	55%
Petrol yield wt. per cent. middle oil converted :—				
butane free	86.5	—	88.5	75.0
butane	3.5	—	3.5	0.5
total	90.0	100	92.0	75.5
Total hydrocarbon gas yield, incl. C_4 in petrol, wt. per cent. of middle oil converted	16.8	1.5	13.0	27.5
H_2 chemical absorbed, wt. per cent. middle oil converted	8.4	5.1	3.0	3.5
Total hydrogen used, wt. per cent. middle oil converted	8.8	5.5	3.4	4.2

sten sulphide catalyst as practised at Billingham in the first years of operation.

(b) Saturation stage operation with the same catalyst, as practised in recent years.

(c) Splitting stage operation with 6434 catalyst for motor spirit production, as used up to the start of the war.

(d) Splitting stage operation with our new catalyst, 231, for aviation base production.

In comparing (c) or (d) with (a), it must be remembered that the hydrogen consumption and gas yields in (b) must be added to (c) and (d).

Fig. 8 gives a flow diagram of the two-stage vapour phase hydrogenation process. In this diagram attention should be drawn to the arrangements for cooling during reaction. It is essential that during the hydrogenation process the temperature should be controlled between the limits of approximately 20°C. All hydrogenation reactions are exothermic, and therefore, if no provision is made for removal of heat, the temperature inside the reactor will rise at a progressively increasing rate due to the positive temperature coefficient of the reaction. This instability of the system is accentuated by the fact that, as temperatures increase, more extensive hydrogenation breakdown to lower molecular weight products occurs—ultimately creosote is converted entirely into methane—and the heat of reaction associated with a given amount of creosote increases correspondingly. This is shown in Table X.

The method now generally used for controlling temperature of vapour-phase reactions was worked out in the first place at Billingham, and comprises a division of the reaction space into numerous sections. Between each two sections the vapours are mixed with cold gas and redistributed over

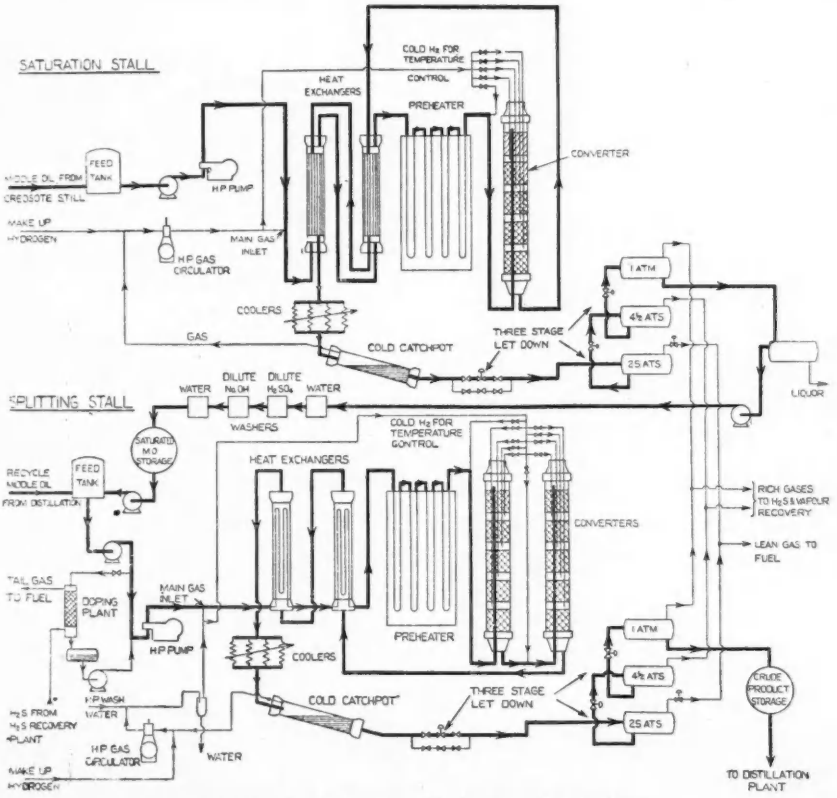

Fig. 8. Vapour-phase hydrogenation stalls.

the next batch of catalyst. Very careful design is needed for this part of the equipment. Fig. 9 is a plot of temperatures through the whole of the two-converter system, and this shows how the cooling gas streams are utilised to maintain the temperature between the proper limits. If temperatures are allowed to get out of hand, highly exothermic reactions supervene. Temperatures soon reach a dangerous point, and only a quick release of pressure will avoid dangerous conditions.

TABLE X.

1 ton creosote +	0.078 tons hydrogen	— 0.92 tons commercial motor petrol + 0.08 tons butane + 0.025 tons other hydrocarbon gases + 540 ton calories
1 ton creosote +	0.086 tons hydrogen	— 0.85 tons aviation petrol + 0.21 tons butane + 0.080 tons other hydrocarbon gases + 590 ton calories
1 ton creosote +	0.213 tons hydrogen	— 1.17 tons methane + 1240 ton calories

In the case of the Heysham plant there was an interesting development in the design of the saturation stage of the vapour phase process. The oil to be used demanded a much lower reaction temperature and a lower contact time than is found necessary with creosote, and, moreover, had a higher average boiling range. To ensure its complete vaporisation, excessive pipeline sizes would have been needed to carry the gas. After the necessary experimental work had been done it was decided to carry out the saturation stage largely in the liquid phase. A special converter design was produced for this purpose following the same principles as in the vapour-phase unit. It was necessary to ensure not only distribution of the vaporised oil over each bed of catalyst, but also even distribution of the part remaining as liquid.

It has been mentioned earlier that the reaction temperature required in the splitting stage of the two-stage vapour phase process is lower than that needed with 5058 in a single treatment, which in turn is considerably lower than the temperature used in the early days with molybdenum catalysts.

A valuable result attending this reduction of splitting reaction temperature is that the formation of methane and ethane is almost entirely avoided. Nearly all the gaseous products are the more valuable propane and butane. An interesting point is that a high proportion—between 70 and 75 per cent—of the butane formed is iso-butane. This proportion, and also the proportion of propane and butane in the gaseous product, appears to be substantially independent of the nature of the feedstock. By changing the end point of the petrol fraction made, it is possible to vary the proportion of butane made between wide limits, as is shown in Table XI.

TABLE XI.

EFFECT OF VARIATION IN EXTENT OF HYDROGENATION ON PETROL AND HYDROCARBON GAS YIELDS.

Raw material: Creosote middle oil.
Process: 5058 saturation followed by 6434 or 231 splitting.

Petrol volatility :—				
Vol. per cent. at 100° C. ...	35	45	55	72
Petrol, F.B.P. ...	200° C.	180° C.	160° C.	133° C.
Yields, per cent. wt. creosote middle oil :—				
Butane free petrol	92.0	88.5	84.5	75.0
Butane	8.0	11.5	15.0	21.0
Propane	2.0	2.5	3.0	4.0
Methane, ethane and analytical errors	0.5	0.5	1.0	4.0
Total hydrocarbon gas	10.5	14.5	19.0	29.0
Hydrogen consumption :— per cent. by wt. of middle oil ...	8.4	8.8	9.2	9.7

The small diminution with increasing volatility in the total production of petrol plus

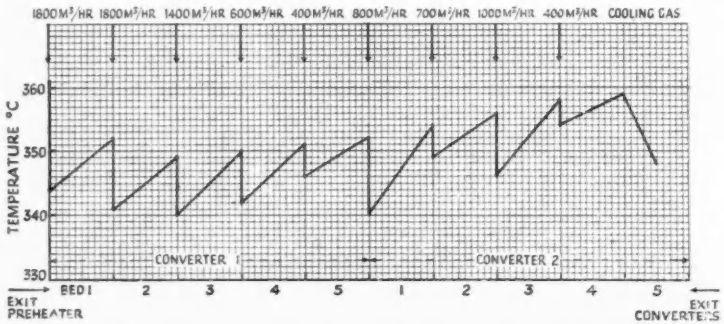

Fig. 9. Temperature gradient through vapour-phase converters.

butane will be noted. With the development of a process for he dehydrogenation of butane to butylene, a relatively high proportion of iso-octane can be made for blending with the base petrol to 100 octane number fuel. The high proportion of isobutane in the C_4 fraction is advantageous in this connection for the manufacture of iso-octane either by the alkylation process or by polymerisation followed by hydrogenation.

A hydrogenation classification of the vapour phase hydrogenation products from creosote oil, made with various catalysts, is indicated in Table XII. Table XIII gives a hydrocarbon analysis of two base petrols for aviation fuels, the first made from creosote and the second from a suitable gas oil. The high proportions of iso-pentane, methyl cyclopentane and methyl cyclohexane will be observed. The very high knock ratings of the fuels will be noted. They are both similar as regards weak mixture ratings, but on rich mixture ratings the high aromatic content of the petrol made from creosote gives it an advantage.

The crude hydrogenation product must be stored in tanks from which air is excluded so as to avoid oxidation of the H_2S content to elemental sulphur. The general practice is to connect the top of the tanks used for storing the crude material to the gasholder containing the rich gas. The pressure from hydrogenation products is released in three stages so as to concentrate the higher molecular weight gaseous fractions in the last stage in order that the gas from the earlier

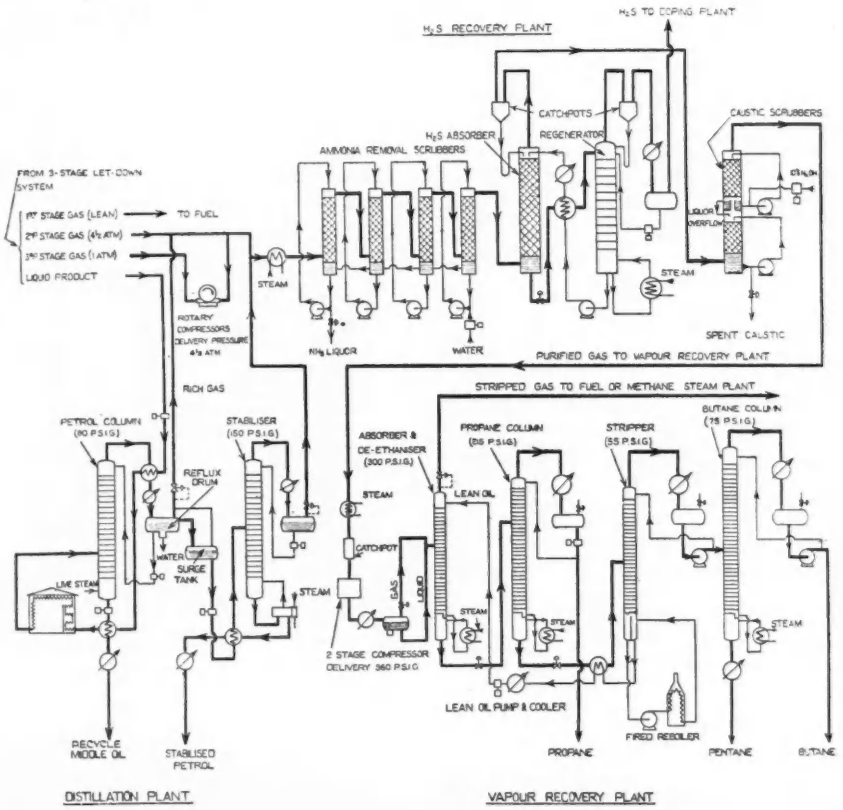

Fig. 10. Product distillation and light hydrocarbon and hydrogen sulphide recovery plants.

stages can be used as fuel directly without loss of valuable components. Fig. 10 is a flow diagram of the plant in use at Billingham for distilling the hydrogenation product and recovering the hydrocarbon gases.

TABLE XII.

COMPOSITION OF MOTOR PETROLS OBTAINABLE FROM CREOSOTE MIDDLE OIL USING VARIOUS HYDROGENATION CATALYSTS.

Process Catalyst	Single stage 64	Single stage 5058	2-stage 5058 saturation. 6434 splitting	2-stage 5058 saturation. 231 splitting
Petrol composition, vol. per cent. —				
Aromatics	43	3	7	15
Naphthenes ...	33	50	54	48
Branched chain paraffins	7	31	33	32
Straight chain paraffins	14	16	6	5
Unsaturated hydrocarbons	3	Nil	Nil	Nil
C.F.R. motor method octane number ...	80	68	75	77

It will be seen that the liquid product goes into a conventional flash-heated distillation column, and that the overheads from this column go to a stabiliser which is controlled to give petrol of the correct vapour pressure. The overheads from the stabiliser join the gases from the last two stages of the let-down system. The gas is first of all washed with water to remove ammonia, which comes from the nitrogen in the oil, and is then scrubbed with alkacid liquor for recovery of H_2S. The H_2S is used for saturating the feed to the vapour-phase stalls in order to maintain catalyst activity.

The gas is given a final purification in a caustic scrubber, and is then compressed to 360 lb. before going to the plant for recovery of gaseous hydrocarbons. The gas is asorbed in oil in a column designed to act both as absorber and de-ethaniser. From the oil, propane is taken overhead in the next column, and the other gaseous products in the third column. Finally, butane is separated from pentanes, the latter being blended in the petrol.

If any new hydrogenation plants are built, it would probably be preferable to run stabilisation units directly in conjunction with the hydrogenation units, since vapour-phase hydrogenation units are so reliable in operation that it is now regarded as unnecessary to interpose storage between the hydrogenation and separation units. Vapour-phase petrol normally requires nothing more than a caustic wash to free it from the last traces of H_2S. In some cases it has been found necessary to add hypochlorite treatment to remove traces of mercaptans which are synthesised in the hydrogenation reaction on account of the presence of H_2S.

In the original Billingham layout the liquid-phase product was separated into gas, petrol, an intermediate boiling range naphtha containing tar acids, middle oil and heavy oil. The petrol obtained directly from coal requires acid treatment. In the German plants this separate treatment of the liquid-phase petrol was avoided by putting the product together with middle oil through the vapour-phase converters so that the liquid-phase petrol was in effect refined by hydrogenation. It is probable that this arrangement is more economical.

Reference has already been made to the substantial quantity of phenol, cresol and other homologues resulting from coal hydrogenation. Plant was installed in 1937 for the recovery of these materials. A suitable naphtha fraction cut to contain the phenols was washed with caustic soda in orifice columns to give sodium phenates. The separated phenate solution was then stripped of neutral oils in a fractionation column. The purified phenate was then "sprung" by

TABLE XIII.

PROPERTIES OF 231 BASE PETROLS FOR 100 OCTANE FUEL.

Feedstock	Creosote	Naphthenic type petroleum gas oil
Composition of feedstock—		
Vol. per cent. aromatics ...	Substantially 100 per cent.	20
Vol. per cent. naphthenes ...	—	65
Vol. per cent. paraffins ...	—	15
Petrol properties		
Specific gravity	0.73	0.705
Distillate recoverable at—		
75° C.	33	42
100° C.	70	72
110° C.	82	83
FBP° C.	133	135
Vol. per cent. aromatics ...	12	5
Vol. per cent. naphthenes	42	30
Vol. per cent. paraffins ...	46	65
Content of individual hydrocarbons, vol. per cent.—		
Benzene	4.0	1.0
Toluene	5.0	3.0
Xylene/ethyl benzene ...	3.0	1.0
Cyclopentane	1.0	0.5
Methyl cyclopentane ...	13.0	7.0
Cyclohexane	2.5	1.0
Dimethyl cyclopentane ...	6.0	5.0
Methyl cyclohexane ...	11.0	9.0
Dimethyl cyclohexanes, etc.	8.0	7.0
Isopentane	17.0	22.0
N-pentane	2.5	2.5
Methylpentanes	10.5	13.5
N-hexane	2.0	2.5
Methyl hexanes	5.5	10.0
N-heptane	0.2	0.5
Dimethyl hexanes ...	1.5	2.5
Methyl heptanes	2.0	5.6
N-octane	0.2	0.5
C.F.R. motor method octane number—	79.0	77.0
+ 4.8 c.c. TEL/gallon ...	93.5	93.5
+ 5.5 c.c. TEL/gallon ...	94.5	94.5
3C Rich rating (per cent. of rating of 8 + 1.25 c.c. TEL/US gallon) of petrol leaded with—		
4.8 c.c./TEL/gallon ...	96.0	82.0
5.5 c.c./TEL/gallon ...	99.0	85.0

CO_2, and the crude phenols separating were further worked up by distillation in a batch column to phenol and various grades of cresol. Fig. 11 is a diagram of this plant.

It was early recognised that the good knock rating of hydropetrol, combined with its high lead susceptibility due to the absence of sulphur compounds, made it a suitable material for aviation fuel. The first product made at Billingham was 87 octane number fuel, which was, in the first place, a straight product from single-stage hydrogenation of coal middle oil and creosote, cut to about 55 per cent volatility. The introduction of the two-stage vapour phase process with catalyst 6434 made it easier to reach the desired specification, since the lead requirement was below the maximum.

Attention was focussed very early on the desirability of the manufacture of 100 octane fuel, preferably from coal. The butane fraction was rich in iso-butane and was an obvious starting-point for the synthesis of iso-octane. A process was worked out at Billingham in 1935-36. The first step necessary is the dehydrogenation of the iso-butane to isobutene, and this was in the first place carried out by thermal cracking with which a moderate yield is obtained. Although it was clear that a practical process could be worked out in this way, the relatively low yield from thermal cracking, combined with the high cost due to the limited amount of butane at Billingham, ruled out practical development. An obvious improvement would be a process for the catalytic dehydrogenation of butane so that high yields of butylene could be obtained.

At about this time a chromium aluminium catalyst for this step was invented by the Shell Development Company, and the process was worked on by the Universal Oil Products Company, with whom we collaborated from an early stage. Experiments were carried out by them at Riverside, near Chicago, and shortly before the outbreak of the war a practical scheme was put forward. A plant for the manufacture of 10,000 tons a year of iso-octane was approved by I.C.I. in the early part of 1939. The process is illustrated in Fig. 12.

The liquid butane feed passes to the dehydrogenation furnace, where it is first preheated in a convection bank. It then flows into one of two reactor banks where catalytic dehydrogenation takes place, represented by the equation:

$$C_4H_{10} \longrightarrow C_4H_8 + H_2 \longrightarrow 29{,}000 \text{ cal.}$$

The reaction takes place in special steel tubes 2-in. in diameter filled with pelleted

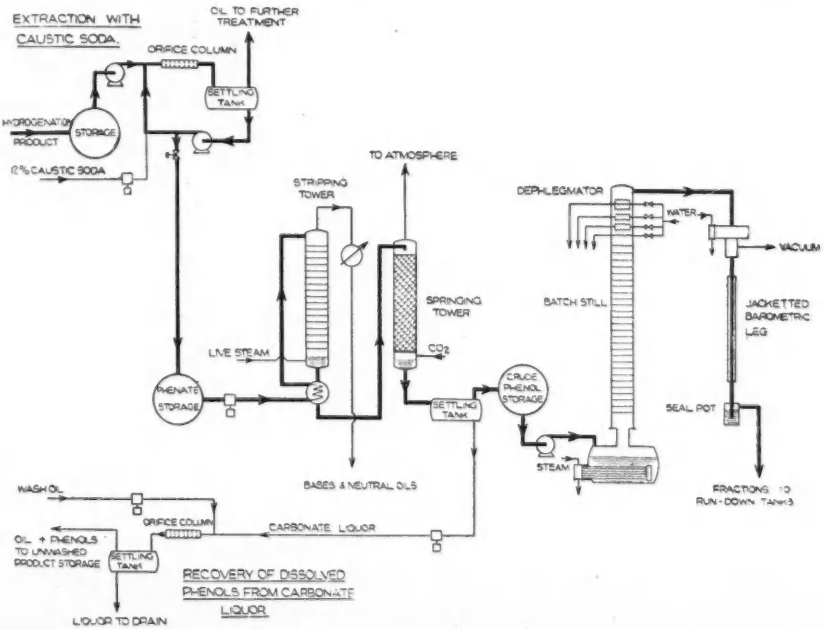

Fig. 11. Extraction of phenols from hydrogenation plant oils.

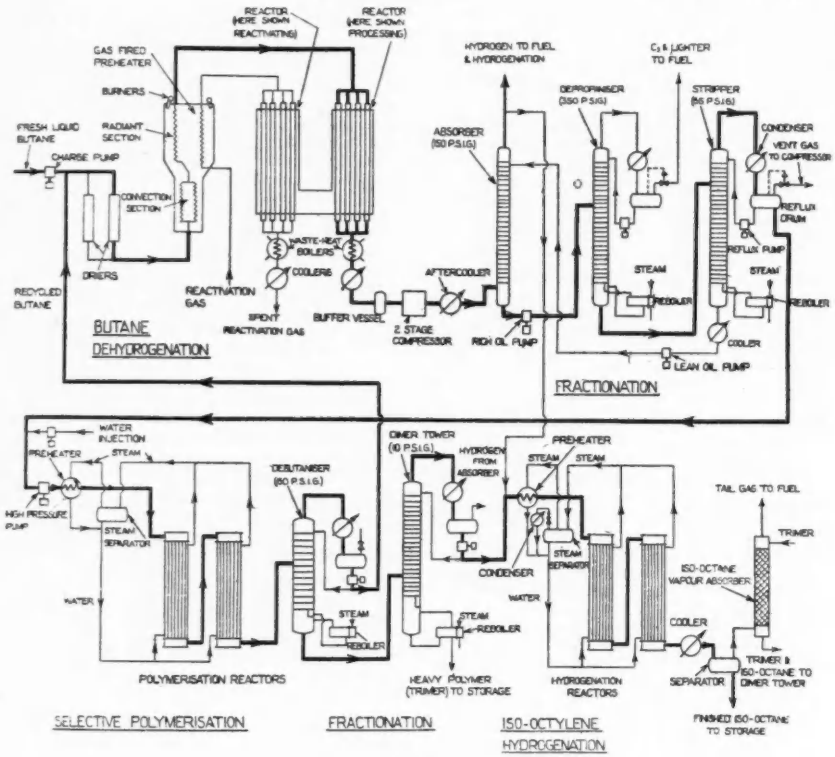

Fig. 12. Iso-octane plant.

catalyst. A conversion of approximately 25 per cent per pass is obtained, which nearly corresponds to equilibrium at the dehydrogenation temperature of 550°C. to 575°C.

During the processing, the pelleted catalyst in the reactor becomes coated with carbon, and after a period of approximately an hour it is necessary to remove this carbon by combustion with gas containing a limited amount of oxygen; this step is called reactivation. The gas stream is, therefore, switched from one reactor to another at regular intervals, and whilst one reactor is processing, the other is being reactivated. The reaction product, after cooling, is compressed and the C_4 hydrocarbons separated from the hydrogen and lighter hydrocarbons formed by absorption with oil. The rich oil is depropanised and then debutanised.

The C_4 fraction passes through tubular polymerisation reactors filled with catalyst of phosphoric acid on kieselguhr, where practically the whole of the butylenes present polymerise to give dimer and trimer. These are freed from the residual butanes in a stabilising column, and the butanes are recycled to dehydrogenation. The dimer and trimer are separated by distillation, and the former is hydrogenated over a nickel catalyst with the hydrogen separated from the dehydrogenation product.

A considerable improvement in this process was made by the discovery of an improved dehydrogenation catalyst by I.C.I. in the early days of the war which has given not only very regular running but a considerably greater output and yield. Operating conditions for this process are shown in Table XIV.

To make 100 octane number fuel, this iso-octane is blended with about three times its weight of vapour-phase petrol. An obvious economy in the process would have been to replace the polymerisation and hydrogenation steps by alkylation. The

high ratio of isobutane to normal butane would have made this specially attractive. Dehydrogenation would have been necessary for only half the butane, and the product alkylated with isobutane. The alkylation process was unfortunately not fully developed at the time when a decision had to be taken. The process adopted has the advantage of giving a superior quality product.

TABLE XIV.

TYPICAL OPERATING DATA FOR ISO-OCTANE PLANT.

DEHYDROGENATION SECTION (Catalyst volume 3.6 m³ in each reactor.)	
Process conditions—	
Fresh feed	50 te/day (69.9 per cent. wt. isobutane, 28.6 per cent. n-butane, 1.5 per cent. propane).
Recycle feed ...	141 te/day (from polymerisation section).
Pressure	Inlet—6 atmospheres.
Temperatures ...	Inlet 550° to 575° C.; exit 530° to 560° C.
Process period ...	1 to 1½ hours.
Olefines in feed to polymerisation ...	24.6 mol. per cent.
Reactivation conditions—	
Reactivation gas ...	5000 m³/hour (2½ per cent. oxygen).
Pressure	Inlet—7 atm.; Exit—3 atm.
Temperature ...	Inlet, 500° C.
Time required to burn off carbon	Approx. 25 minutes.
Total time on reactivation	Same as process period.
POLYMERISATION SECTION.	
Catalyst volume ...	3.2 m³ in each reactor.
Pressure	Inlet, approx. 55 atmospheres.
Temperature ...	140° C. to 170° C.
Olefines in recycle butanes	3 mol. per cent.
HYDROGENATION SECTION.	
Catalyst volume ...	0.5 m³ in each reactor.
Ratio of inlet gas to feed	400 m³/te.
Pressure	Inlet, 7½ atmospheres.
Temperature ...	150° C. to 185° C.

OVERALL BALANCE (Weight per cent.)

In			*Out*		
fresh feed	butane	100.0	iso-octane		78.5
	propane	1.5	trimer		3.7
			carbon		0.8
			gas		11.8
			loss		6.7
Total		101.5			101.5

PROPERTIES OF ISO-OCTANE.

Specific gravity (15°/15°C.)		0.713
Distillation	Initial B.P.	57° C.
	5 per cent. vol. at ...	100° C.
	50 per cent. vol. at	108° C.
	95 per cent. vol. at	146° C.
	Final B.P.	172° C.
Bromine number (McIlhiney)		>1
Reid vapour pressure		4 lb./sq. in.

Engine ratings (blending values in blend of 25 wt. per cent. iso-octane and 75 per cent. hydropetrol; plus 4.8 c.c. TEL per Imperial gallon):—

Weak (CFR motor method) ...	110
Rich (per cent. "S+1.25") ...	123

Alkylated benzenes are valuable aviation spirit components. They do not enhance the weak mixture rating to the extent that is done by octanes, but they do have a very marked effect indeed on the rich mixture ratings. Some work in this field was done in connection with aviation fuel work in 1935 and 1936 at Billingham. In 1943 the demand for rich mixture components was very great, and after some experimental work it was decided to replace to a large extent at least the iso-octane manufacture at Billingham by the production of butyl benzene to which the appropriate code name "Victane" was given. Butyl benzene was for all practical purposes the equivalent of cumene (isopropyl benzene) which was made on such a large scale in the U.S.A. for the same purpose. The process of manufacture is very similar.

TABLE XV.

TYPICAL OPERATING DATA FOR VICTANE PLANT.

Catalyst volume ...	9.35 m³.		
Converter pressures ...	inlet 53 atm., exit 50 atm.		
Converter temperatures	inlet 263° C., exit 260° C. average, 263° C.		
Feed		tonnes/hour	tonnes/hour
Isobutylene		1.48	—
N-butylene		0.67	—
Butanes		6.45	—
Total			8.6
Water			0.02
Recycle benzole		15.8	—
Make-up benzole		2.8	—
			18.6
Total			27.22
Products			
Victane (butyl benzene) ...		4.1	—
Victane bottoms		0.2	—
Butanes		6.45	—
Olefines		0.15	—
Recycle benzol		15.8	—
Purge and loss		0.52	—
Total			27.22
Conversion—			
of olefins		92.4 per cent.	
of isobutylene ...		93.7 per cent.	
Properties of Victane—			
Specific gravity (15°/15° C.)		0.859	
Distillation			
Initial B.P. ...	...	110° C.	
5 per cent. vol. at	...	130° C.	
50 per cent. vol. at	...	164° C.	
95 per cent. vol. at	...	169° C.	
Final B.P.		176° C.	

Engine ratings
(blending values in blend of 12 wt. per cent. Victane and 88 wt. per cent. hydropetrol; plus 5.5 c.c. TEL per Imperial gallon)

Weak (C.F.R. motor method)	105
Rich (per cent. "S+1.25") ...	159

At Billingham the butane/butylene stream from the dehydrogenation plant was pumped into one of the hydrogenation converters together with excess of benzene, which had been purified by hydrogenation. Phosphoric acid on kieselguhr was used as the catalyst. To maintain catalyst activity, a definite proportion of water must be introduced with the feed. The crude reaction product was separated by distillation into recycle butanes, unconverted benzene, butyl benzene and heavier alkylates. The residual

butane/butylene fraction passed through the polymerisation reactors and produced a small quantity of iso-octane. A flow diagram of the process is shown in Fig. 13, and the operating conditions are shown in Table XV.

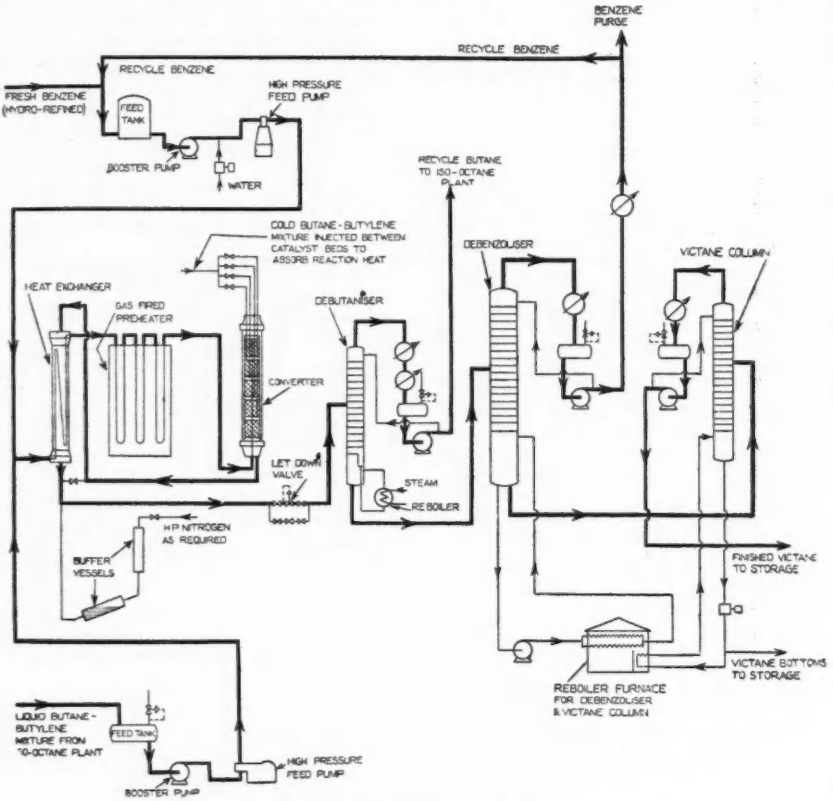

Fig. 13. Victane manufacture.

PHENOTHIAZINE IN PEST CONTROL

Long known as a chemical compound for the control of internal parasites in a variety of animals, phenothiazine, according to E.I. Du Pont de Nemours & Co., has found a new field of economic usefulness, as an insecticide for the control of the codling moth. Combined with lead arsenate, Du Pont's agricultural grade of phenothiazine, in numerous experiments and demonstrations undertaken in Pennsylvania, Virginia, West Virginia, Maryland, Delaware, and New Jersey, has revealed outstanding control of the codling moth. At the present time tests are also being made in New York and other apple-growing States, where interest in the new combination spray is high.

A new method for the manufacture of turpentine has been announced by the United States Department of Agriculture. It is reported to be cheaper and speedier than the so-called batch method used at present. Preheated gum from pine trees is put in a continuous steam still of novel construction, which yields turpentine and rosin. The end-products are said to be better than those produced by conventional methods.

British Association of Chemists

Political Fund to be put into Operation

THE British Association of Chemists is to put a political fund into active operation as a result of a decision made at the 29th annual general meeting at the Adelphi Hotel, Liverpool, on December 7, following a resolution put forward by the Manchester Section.

During the discussion it was urged that it was an advantage to have a fund from which chemists of all political parties might receive assistance when seeking election on public bodies. There would be no suggestion of assisting any particular party. The object was to assists chemists to play their part in public affairs, and to let them feel that they had the goodwill of their fellows. The hon. secretary, Mr. J. Stewart Cook, pointed out that the officers for the coming year included a president who was a Conservative borough councillor, an hon. secretary who was Labour, and a vice-president who was a Liberal. The Association did include all parties, and it was likely that they would see fair-play.

The retiring president, Professor R. G. W. Norrish, D.Sc., F.R.I.C., F.R.S., was in the chair. After the adoption of the treasurer's report and the report of Council, Professor Norrish presented the Hinchley Medal to Mr. C. S. Garland, B.Sc., A.R.C.S., F.R.I.C., M.I.Chem.E., and in doing so paid tribute to the work which Mr. Garland had done for the association over a long period of years. He referred to the affection with which Mr. Garland was regarded as one of the founder members, and to the way in which he had made his influence felt among employers and employees alike. His pioneer work, in many directions, was of great value to the profession. Mr. Garland thanked the meeting for the honour he had received, and for the generous terms in which the president had referred to him. He spoke of his affection for Professor Hinchley and said how proud he was to have a medal which bears his name. He wished the association success in its work, and said that it had a valuable function to perform for chemists.

The New Officers

Officers for the ensuing year were elected as follows: *President*, Mr. Norman Sheldon, A.R.C.S., F.R.I.C.; *vice-presidents*: Professor R. G. W. Norrish, D.Sc., F.R.I.C., F.R.S.; Dr. J. B. Matthews, B.Sc., Ph.D.; Mr. J. Wilson, M.C., M.Sc., M.I.R.I., F.R.I.C.; Mr. C. A. Wylie; *hon. secretary*, Mr. J. Stewart Cook, B.Sc., A.R.C.S., A.R.I.C.; *hon. treasurer*, Mr. W. C. Peck, M.Sc., F.R.I.C., A.M.I.Mech.E., M.I.Chem.E.; *hon. registrar*, Mr. H. L. Howard, B.Sc., A.R.C.S., F.R.I.C., M.I.Chem.E., D.I.C.; *hon. editor*, Mr. T. Crosbie Walsh, F.R.I.C.; *trustees*: Dr. P. Haas, Ph.D., D.Sc., Mr. F. Scholefield, M.Sc., F.R.I.C., Mr. C. A. Wylie; *general councillors*: Mr. D. Jackson, B.Sc., A.R.C.S., Mr. A. J. Mills, A.C.G.F.C., A.R.I.C., Mrs. S. M. L. Tritton, F.R.I.C., M.P.S., Mr. J. Wilson, M.C., M.Sc., M.I.R.I., F.R.I.C.

Mr. Norman Sheldon.

Professor Norrish spoke of the work of the association during the past year, and reminded the audience that the association fulfils a very important function, not fulfilled by any other body. The association claims to speak for the chemical profession on all matters concerning the employment and the economic interests of chemists. In order to do this more efficiently, the association must be developed by the recruitment of the right type of members, and must work in collaboration with other bodies, such as the Royal Institute of Chemistry and the Association of Scientific Workers.

Introducing Mr. Norman Sheldon as the new president, Professor Norrish paid tribute to his energetic work for the association in the past, commending him as a keen, vigorous business man, and as a leader. The election of Mr. Sheldon was greeted by the members with hearty and prolonged applause.

Two proposed alterations to the rules were adopted. One gave authority to increase benefits, under the Employment Benefit Fund, and the other established the office of honorary life vice-president. Professor E. C. C. Baly, C.B.E., F.R.S., was elected to that office in recognition of the valuable work he had done for the association during the past years.

At the close, Mr. Sheldon paid tribute to the work of Professor Norrish, who had been president during a very difficult time.

He expressed the thanks of the association for the very sincere hard work which Professor Norrish had performed in their interests, and moved a hearty vote of thanks, which was accorded with enthusiasm.

Statement of Policy

Mr. Sheldon has issued the following "Statement of Policy":

In assuming the office of president of the British Association of Chemists, I would like to make known to British chemists the policy for which the association stands and which it is my duty and pleasure to uphold. The British Association of Chemists is not, nor does it pretend to be, a qualifying body, but it is the only organisation which exists for the sole purpose of looking after the economic interests of the chemical profession.

We seek to strengthen the individuality of our members by giving financial support when seeking new employment. We do this by means of our Unemployment Benefit Fund, which has a reserve of over £42,000, and which has paid out many thousands of pounds to members in order that they may not be forced to accept employment with inadequate remuneration or unsatisfactory conditions of service. We are exploring the possibility of setting up a superannuation scheme, which will be transferable when a member moves from one firm to another, and we hope to extend our unemployment benefit scheme to cover loss of income through sickness or accident and to pay an income for life to those who may be so unfortunate as to become totally and permanently disabled. To those desiring a change of employment we provide a comprehensive appointments service.

Official Recognition

We believe that professional men should combine in this way in order to supplement the meagre benefits offered by State insurance. Such a financial background would enable our younger members to plan their careers with confidence, strengthened by the knowledge that if they did meet with difficulties they would not be crippled financially. It is our intention to pursue with the utmost vigour a policy leading to the official recognition of the association by industrial firms, Government departments, and public authorities as the appropriate body with whom all matters relating to the economic interests and the status of chemists should be discussed.

In order that some of these functions may be performed more efficiently and with the assistance and co-operation of Government departments, we are registered as a trade union. Let it not be thought, however, that this means that we are in any way associated with any particular political party, for we have set our face resolutely against any bias of a party character. We believe that our members are entitled to play their part as individuals in the field of public affairs, and we should encourage them to do so, but as a body we believe that it would be wrong to be associated with any political propaganda of a party character. One of the most important of our activities is the formation of student groups through which students of chemistry can take an interest in matters concerning their present and future economic welfare and secure the co-operation and advice of the senior members. We can assist students who may be seeking financial aid from Government departments in order to continue their studies.

We seek to co-operate with all other organisations who may be concerned with the problems in which we are interested and invite all members of the chemical profession to join the association and play their part in the many vital issues which will face us during the next few years.

U.K. Steel Output

Record Figures for November

THE production of steel in the U.K. during November was at the highest rate reached in any month this year. Output was 1,055,000 tons for the four weeks, a rate of 13,715,000 tons a year, compared with 990,000 tons, or annual rate of 12,870,000 tons for November, 1945. The output was greatly in excess of November, 1938, the last pre-war year, when the rate was 10,320,000 tons a year.

Pig-iron output during the four weeks of November was 615,000 tons, a rate of 7,903,000 tons a year, compared with 600,000 tons, or an annual rate of 7,801,000 tons for the same month last year. The pig-iron figures were slightly reduced by a temporary interruption to production at one of the works. Figures given in the tables below represent tons.

STEEL INGOTS AND CASTINGS

	Weekly Average 1945	1946
First quarter ...	233,200	242,600
Second quarter ...	227,200	252,100
Third quarter ...	132,600	146,600
October	243,200	254,300
November	247,500	263,800

PIG IRON

	Weekly Average 1945	1946
First quarter ...	134,500	145,500
Second quarter ...	132,600	150,500
Third quarter ...	132,600	146,600
October	146,100	155,800
November	150,000	153,900

MANAGEMENT PROBLEMS

In order to assist subscribers in the solution of their management problems we invite questions relating to such matters as accounting, costing, control of plant and materials, office methods, income tax, etc. Correspondents will be answered under initials but should give their names and addresses which will not be published, and when documents of any kind are sent to us they should be copies only, as they cannot be returned. Letters should be addressed to the Editor.

Query.—" We have two manufacturing sections, one producing the crude material and the other using this material for the manufacture of pure products. The question frequently arises as to whether crude transferred to the purifying plant should be calcculated at cost price or market price. Can you help us to decide this point?—H.B. & S.

Reply.—When a single product is manufactured, the calculation of the unit cost is relatively simple, but when there are a number of products of different market value it is difficult to estimate the proportion of labour, fuel, etc., used in the production of each quality. Comparative costs are usually compiled on the basis of each unit of raw material, and the raw products transferred at market prices, but so long as the bearing of the system is borne in mind it matters very little in practice.

Buying Department

Query.—" Apart from the restricted supply of materials the need for ready money to satisfy local creditors compels me to limit my trade purchases. However, I propose to acquire more stock, and a little advice on the organisation of the buying department would be useful,"—A.C.M.

Reply.—It should never be forgotten that a small turnover will absorb much more capital, relatively speaking, than will a large turnover. Unless, therefore, there are urgent reasons for adopting such a course, stocks should never be permitted to dwindle below that minimum which experience has proved advisable to carry. When the number, weight or quantity under any heading threatens to reach the minimum, it is a good practice to make an entry in a book kept for that purpose. This book may be provided with columns or sections for the insertion of such details as the date, a description of the materials or stores required (including the quantity) and for any special observations or remarks, but, of course, the precise ruling will depend on the size of the business and the class of trade. If a separate section is provided for office use, this section may comprise columns for showing the date on which each order was given out, the name of the supplier, the date on which the goods or articles arrived on the premises, and any other essential information.

Each order form should be signed, and it should be made quite clear to suppliers that any deviation from the particulars will be entirely at their own risk. Sometimes it will be advisable to state the latest date for delivery, or the terms and conditions. When dealing with a firm of suppliers for the first time a special effort should be made to avoid misunderstandings. The invoices received should be stamped by means of a rubber stamp or other suitable impression, and should be carefully checked as to price and discount before making any entry in the purchases journal or bought day book.

Costing in Research

Query.—" As a research worker, I should be interested to know if you think that accounts compiled by the costing department are really of greater value than estimates of expenditure from laboratory conditions."—T.J.

Reply.—As cost accounts show the cost of manufacturing a particular product on a scale of process expenditure which has already been in actual operation, and as they embody charges and items that cannot always be foreseen under laboratory conditions, the costing department is of great value in research and can often indicate material economies in the use of by-products. The careless use of raw materials will often send up costs, and this is not always allowed for in the laboratory. Moreover, the application of a costing system can exert a great moral influence on the staff, and this is important.

Contingencies

Query.—" When our next stocktaking comes round we intend to make the fullest possible provision we can against such contingencies as bad debts, discounts, repairs, and maintenance of plant and equipment, etc. Could you outline the customary procedure and indicate some of the book work this would entail?"—G. & T.

Rely.—Provision against book debts that are uncertain of collection can be made by calculating a certain percentage of the total sum owing by customers as per ledger. In some cases the percentage may be as low as 1 per cent; in others it may be 5 per cent or more, and having determined the amount to be reserved an entry should be made on the debit side of the bad debts account, with the words " To reserve." This amount

should be shown as the last item in the account and will be included in the amount transferred to the debit side of the periodical profit and loss account. It will also be brought down as the opening entry on the credit side of the bad debts account to commence the next period, but instead of showing it as a separate item on the liabilities side of the balance sheet it should be deducted from the figure of sundry debtors as shown on the assets side. A more satisfactory method of providing for irrecoverable debts is to examine carefully all the items enumerated in the list of outstanding balances, and to make a list of all amounts which are bad or doubtful of collection. The total of this list would be the sum to be reserved, although, of course, special attention should always be given to large amounts which have been owing for an unduly long period.

If customers are allowed a discount in respect of the prompt settlement of their accounts, or for payment within a stipulated or a recognised period, a sum may be reserved at balancing time to cover the discounts on sundry debtors. This reserve is usually based on the total of the ledger balances outstanding as per ledger at the date of stocktaking, and the percentage taken should correspond, as near as possible, with the ratio which the total of the discounts actually allowed to customers during the accounting period bears to the total amount of cash received from them. The reserve should be shown as the last entry in the discounts account, and included in the charge against the trading, and should be deducted from the figure of sundry debtors when drafting the balance sheet.

In the matter of repairs and maintenance of plant and equipment, a reserve may be made even though repairs are not likely to be put in hand for some time. The amount on the debit side of the repairs and renewals account should not exceed the average for the past two or three years, and the reserve should be treated as a liability when drawing up the final accounts. If the particular book-keeping system in operation does not guarantee that all invoices for materials and charges have been entered in the books, adequate reserves should be made to cover the liabilities which have been incurred, including all apportionments due to overlapping.

Branch Expenses

Query.—"We are endeavouring to make an equitable distribution of branch selling expenses as a part of the administrative overhead charges and wish to know if any expenses other than the salaries and travelling expenses of the salesmen should be included."—J.E.

Reply.—In addition to the salaries and expenses of direct salesmen, the expenses of a branch include the salaries of the manager and of the clerical staff, and the cost of general maintenance and upkeep of the premises. The total expenses should be compared with the estimates, and may be divided by the number of items to secure a per item charge.

German Technical Reports

Some Recent Publications

SOME of the latest technical reports from the Intelligence Committee in Germany are detailed below. Copies are obtainable from H. M. Stationery Office at the prices stated.

BIOS 779. *Hereaus Vacuumschmelze A.G., Hanau A.M. and at Sterbfritz*: Production of seamless metallic pyrometer sheaths and electric resistance alloys (1s. 6d.).

BIOS 781. Synthetic-resin moulding plants and processes (4s. 6d.).

BIOS 811. *Dr. Alexander Wacker, Gesellschaft für Electrochemische Industrie, Burghausen*: Tetrachlorethane, vinyl chloride and polyvinyl chloride (2s. 6d.).

BIOS 815. *I.G. Farben A.G., Leverkusen*: Manufacture of hydrazine hydrate (6d.).

BIOS 817. *Krupp Treibstoffwerke, Wanne-Eickel*: Krupp-Lurgi low temperature carbonisation plant (1s.).

BIOS 834. *Kohlenwertstoff Verbaende A.G. Bochum*: Benzole and tar products distribution (1s.).

BIOS 886. Manufacture of hydrogen peroxide (2s.).

FIAT 715. *I.G. Farben, Th. Goldschmidt A.G., Permutit A.G., and Chemische Werke Albert*: Ion exchange, coating and plywood resins (5s.).

FIAT 723. Carbon bisulphide manufacture (4s. 6d.).

FIAT 767. Research on zinc base bearings (1s. 6d.).

FIAT 788. Aluminium hydroxy chloride production at Ludwigshafen by electrochemical and chemical methods (1s.).

FIAT 790. Production of sodium sulphide from sodium amalgam (1s.).

FIAT 799. Krupp-Renn and other processes for utilising low-grade iron ores (2s. 6d.).

Manufacture of Wofatit

Base-Exchange Resins—Uses and Properties

BIOS Report No. 621, prepared by Dr. N. E. Topp, D.S.I.R., on behalf of BIOS Team 1901, provides fairly detailed information on the manufacture and uses of resins having ion-exchange properties. These materials were formerly made at I.G. Wolfen, but manufacture is now being instituted at I.G. Leverkusen. Six different resins are marketed under the trade name "Wofatit," five of them being cation exchangers, types P, D, K, KS, and C, and the sixth (type M) being an anion exchanger.

Both Wofatit P and D are prepared from phenol, formaldehyde, and sodium sulphite, the resultant polymer being treated with sulphuric acid to promote further cross-linking, to eliminate any free alkali and at the same time to sulphonate the resin. Wofatit C is manufactured from 1.3.5 resorcylic acid (with or without admixture of phenol or resorcinol) and formalin, caustic soda being used as the condensing agent. The raw materials for Wofatit KS are benzaldehyde 2.4 disulphonic acid, phenol, resorcinol and formalin, which are condensed under acidic conditions, whereas for Wofatit K the same components are reacted in alkaline solution. Wofatit M, as an anion-exchange material is made from basic materials, *m*-phenylene diamine, polyethylene diamine and formaldehyde being condensed using hydrochloric acid as a reaction promoter. Full details of quantities, temperature, times, etc., are included in the text, which also details a list of the plant used in the manufacturing processes.

The principal use is for water-softening, type K or KS having been designed for use where large capacities at moderate temperatures (50° to 70°C.) are desired. For high temperatures (about 100°C.) type P is recommended, but the capacity is halved. Type C is a buffer filter, but can also be used to remove bicarbonate hardness. Applications mentioned in the report include feedwater for high pressure boilers, viscose manufacture, textile bleaching, dyeing, and brewing.

Ammonia and copper, which accumulate in the water used to regenerate cellulose from cuprammonium/cellulose solution can be removed by the use of Wofatit D. The difficulties due to the swelling of resin originally used for this purpose were overcome by altering the chemical constitution and, although the life was improved, capacity was reduced.

Properties

The following table published by Wesley (*Chem. Zeit.*, 1943, *67*, 338) and quoted in the report, gives details of the properties of the resins under working conditions:

Resin type	*Swollen weight of one litre (grams)*	*Particle size (m.m.)*	*Useful capacity kg. of CaO per 100 litres*	*Residual Hardness °G*	*Filter rate m^3 water m^3 resin per hour*	*Max. operating temp. °C.*	*P (e) value*
A	750-800	0.5-2.5	0.8-1.0 (*a*)	0.04-0.1	10-17	30	0
			0.7-0.9				
P	800-850	0.3-2.0	0.7-0.9 (*a*)	0.03-0.08	10-20 (*b*)	95	0
					20-30 (*c*)	75	0.3-0.4
			0.6-0.8				
K	850-900	0.3-1.5	1.8-2.0 (*a*)	0.02-0.05	15-25	50	0
			1.0-1.2				
KS	850-900	0.3-1.5	1.6-1.8 (*a*)	0.02-0.05	15-25	70	0
						50	0.3-0.4
			1.0-1.2				
M	800-850	0.3-2.0	1.0-1.3 (*d*)	SO_4'' nil Cl' 2-8 mg/1	5-10	95	
M			2.0-2.3 (*d*)				
C			1.2-2.2				

(*a*) as a hydrogen exchanger
(*b*) cold water.
(*c*) for hot water.
(*d*) figures quoted by Dr. Griessbach (I.G., Wolfen).

(*e*) The "P" value is a measure of the alkalinity and carbonate content of a water and is defined by the number of ccs. normal hydrochloric acid required to make one litre of the water neutral to phenolphthalein.

Both Wofatit KS and M can be used for sugar purification. Feedwaters for the emulsion polymerisation of vinyl chloride are reduced in hardness from 30° (German) to 0.03/0.06° by the use of Wofatit KS and M.

Other applications mentioned relate to the preparation of cobalt and nickel and recovery of silver from photographic residues, while the purification of gelatin and the recovery of phenol and acetic acid from various effluents are mentioned as possible fields of use.

Wofatit D is regenerated by sulphuric acid, types P, K, and KS being regenerated by a 7 per cent to 10 per cent solution of sodium chloride or hydrochloric acid, depending upon whether the resins have been used in the sodium or hydrogen cycle. Caustic soda or sodium bicarbonate is used for the regeneration of type M.

Lactic Acid from Sulphite Waste

Possible Solution of Pollution Problem

THE disposal of sulphite waste liquor is a serious problem that confronts the paper industry. At the present time most of this waste is discharged into rivers, lakes, or other bodies of water and results in a serious pollution that is objectionable to health and conservancy bodies. An industrial fellowship was established at the University of Wisconsin, U.S.A., by the Rhinelander Paper Company for a study of the fermentation of sulphite waste liquor to useful chemicals, the results of the work to be made available for the public interest or welfare.

Of the chemicals normally produced by fermentation, the production of lactic acid has not been previously attempted on sulphite waste liquor. It was found that the fermentation of the wood sugars was readily possible after suitable treatment of the liquor. Efforts were then directed toward problems dealing with the process as a whole. At the present time sufficient information is available from laboratory investigations to permit preliminary evaluation of the process and further expansion if necessary.

The laboratory results may be summarised as follows: The acid liquor from the blow-pits was best prepared for fermentation by steam stripping to remove sulphur dioxide and subsequent neutralisation to a slightly alkaline condition with slaked lime. After filtration to remove the sulphite precipitate and adjustment to the desired acidity by the addition of carbon dioxide the liquor was ready for fermentation. An inoculum was prepared of a lactic acid-producing organism, *Lacto- bacillus pentosus* 124-2, on a rich medium. The inoculum medium was preferably composed of malt sprouts and molasses although other preparations were known to serve equally as well. The fermentation required 40 to 48 hours at 30° C. for completion. During this period the lactic acid formed was neutralised by addition of calcium carbonate or slaked lime. Usually 1.8 per cent lactic acid was formed during fermentation.

The recovery of lactic acid was perhaps of greater difficulty than the fermentation itself. Recovery was best accomplished by first concentrating the fermented liquor from 12.5 per cent solids and 1.8 per cent lactic acid to about 40 per cent solids and 6 per cent lactic acid. Several solvents were selected which would extract the acids from the waste liquor and would not extract large amounts of impurity. Extractions were made successfully at 90° C. since at this temperature the high viscosity of the concentrate at room temperature may be avoided. The acids were then washed out of the solvent with water and this final aqueous solution was concentrated. The acetic acid which was naturally present in the liquor was removed by distillation. The purity of the crude concentrate varied with the solvent employed; with amyl alcohols the lactic acid was of 90 per cent strength, 8 per cent non-volatile impurity, and 2 per cent water. Methods for separating the lactic acid from the non-volatile impurity are under investigation.

Assuming 2,000 gallons of waste liquor per ton of pulp and 95 per cent recovery by the extractions, 285 lb. of lactic acid and 75 lb. of acetic acid may be obtained per ton. The yields varied with the wood species and the cooking procedure. However, the tremendous potential capacity of a single sulphite pulp mill would far exceed the present demands for the product; 9,000,000 lb. of lactic acid annually from a mill producing 100 tons of pulp daily in a 300-day year. The cost of raw materials and steam was computed on the laboratory data at 3.4 cents per lb. of acid recovered. If the lignin were useable as fuel, the cost might be reduced to 2.5 cents and the process would give a complete utilisation of sulphite waste liquor. It should be pointed out that no estimate is available for initial cost of a plant.

French official statistics show that France's October exports of chemicals to foreign countries were valued at 744,885,000 francs, as compared with 844,887,000 francs in September. Exports to French colonies rose in value from 285,126,000 francs to 307,330,000 francs.

Coal Research

Mr. R. W. Foot Stresses its Value

THE importance of research to the industries represented was emphasised by Mr. R. W. Foot in his presidential address at a luncheon given by the British Coal Utilisation Research Association in London recently.

"In my report to the council on the future work of C.U.R.A.," said Mr. Foot, "I expressed the opinion that in my view the ultimate success of this research association will be measured by the extent to which its discoveries, to use a general term, will in fact have been taken up and profitably used by the factories and homes of this country. I believe that this is the cardinal point to which any research association should direct its aims."

Mr. Foot was taking what he described as his last opportunity to address the Association as president before the nationalisation of the coal industry on January 1. He was able to announce that the National Coal Board—whose chairman, Lord Hyndley, was present—had accepted the principle that, from January 1, the Board should "step into the shoes" of the Mining Association in its relations with C.U.R.A.

The president's address reviewed the accomplishments of C.U.R.A., which is only now in its ninth year, and its plans for the future.

Down-Jet Furnace

Among the discoveries resulting from the Association's research work to which he referred was that of the down-jet furnace which, he said, had now been brought to the stage where it could be tried out in various applications in industry. For example, at Leatherhead they had a small furnace and boiler which together were not larger than an ordinary filing cabinet and which could produce 200 lb. of steam an hour at a pressure of 200 lb. per sq. in. Combustion was absolutely smokeless and the furnace could be started automatically from cold and give steam within a few minutes. The whole unit weighed about 6 cwt. and was self-contained; it could, if required, be mounted on a trolley and transported from place to place. The furnace would run for eight hours without any attention other than the requirements of the fuel hopper and was immediately responsive to varying steam demands.

So far as Mr. Foot was aware, this was the first unit which had ever been designed to use solid fuel and give all such advantages. Other prototype furnaces, he said, were being designed for use in the steel industry, in the refractories industry and for mould drying. Its application for use with gas turbines was also under consideration. Up to the present, no satisfactory method of firing a gas turbine with gases from solid fuel had been developed, and the Association had every hope that the down-jet furnace would prove suitable.

Referring to the Research Laboratories as the "basis of all their work," Mr. Foot mentioned investigation at present in hand of chemical products of coal, where, he said, they were pursuing one or two lines of thought which might develop into matters of interest to the chemical industry.

Oil and Colour Chemists' Association

Lecture on Rheological Phenomena

THE third meeting of the 1946-47 Session of the Bristol Section of the Oil and Colour Chemists' Association was held at the Royal Hotel, Bristol, recently, when Dr. W. J. Dunning, M.B.E., gave a paper entitled "The Rheology of Solid/Liquid Dispersions."

The lecturer introduced his subject by citing honey, clay, and rubber as every-day examples of rheological phenomena. He pointed out the word "rheology" was of American origin and meant the science of deformation and flow. The difference between false-body and thixotropy was explained by the ability of the former to regain its original viscosity more rapidly than the latter after shearing stress had been removed. Thixotropic systems were characterised by a lattice structure and it was considered that this was maintained by Van der Waals' forces. The mathematical conception of flow phenomena had been studied by Einstein.

Experimental work carried out by the lecturer had been based on the use, as the continuous phase, of chlorinated diphenyl with a viscosity of 108-109 poises and which is a Newtonian fluid, and natural and synthetic rubber lattices as the disperse phases. Work on systems on which the continuous phase was considerably less viscous had not been carried out because it had not been possible to find a Newtonian fluid of low viscosity with a low modulus of elasticity.

The lecturer said that evidence had been secured that grinding of a pigment/oil system did reduce the particle size of the suspended solid and explained his experimental methods on a special type of knurled two roll mill. Experiments were described in which the sedimentation value of a pigment was reduced by adding small amounts of lecithin. The methods adopted during the experimental work were ingenious. The lecturer claimed that the determination of value was a measure of efficacy of any specific grinding method.

PARLIAMENTARY TOPICS

IN the House of Commons last week, several questions of interest to the chemical industry were put down. They ranged from housing of German scientists to glue imports.

Housing of German Scientists. — The acquisition by the Ministry of Works, for the use of German scientists, of Spedan Towers, a "large house with two acres of land" in Hampstead, London, was questioned by Mr. A. Lewis, who asked if the Minister would consider using this property for rehousing "bombed-out" people and placing the German scientists in Army Nissen huts.

Mr. Tomlinson explained that Spedan Towers had been requisitioned when vacant in 1940 by the War Department, but was now surplus to that Department's requirements. The Ministry of Health did not require it for housing as it could not be readily converted into flats; and it had been taken over by the Ministry of Works to house German scientists.

Dismantling of German Plants. — Sixty plants, including two concerned with metallurgy and three with chemicals, are at present scheduled to be dismantled in the British zone of Germany, stated the Chancellor of the Duchy of Lancaster, replying to Mr. F. Willey.

Linseed Oil from Argentina.—Reference was made to the agreement with the Argentine Government for the shipment of oils in 1947 when Colonel J. R. H. Hutchison asked the Minister of Food to what industries and in what proportions the 100,000 tons of linseed oil purchased would be allocated. Dr. Summerskill replied that it was too early to say how it would be allocated.

Brigadier Maclean sought assurance that a fair share would be given to the linoleum industry which, he said, was in "very bad state" owing to inadequate supplies. Dr. Summerskill, explaining that allocations were made by a committee representing all departments, was sure every industry would be taken into consideration.

Production of Groundnuts.—The scheme for large-scale production of groundnuts in East Africa was referred to by Mr. Turton in a question to the Secretary of State for the Colonies, advocating full publicity in the West African colonies to the Government announcement that it had complete confidence in the United Africa Company for the initiation of the scheme, based on the company's experience in East Africa.

Asked by Mr. Oliver Stanley when and in what form he intended to give the House full details of these plans, Mr. Creche Jones referred the question to the Ministry of Food which, he said, would take responsibility, though there would be fullest consultation with the Colonial Governments and the Colonial Office.

Palestine Potash. — Major Legge-Bourke asked the Secretary of State for the Colonies what steps were being taken to avoid the necessity of the Palestine Potash Company stopping production and what stocks were at present available.

Mr. Creche Jones replied that the Palestine railway resumed a full-time freight service the previous day and it was expected that the transport of potash to Haifa would return to normal within a few days. The stock of potash accumulated owing to the interruption of the railway freight service amounted to 20,000 tons.

Penicillin Lozenges. — The Minister of Health was asked by Mr. J. Lewis to prohibit use of penicillin for the production of lozenges which, apart from civilian requirements, he said, were absorbing 250,000,000 units for Service Department requirements, "in view of the fact that a lozenge containing only 500 units of penicillin was useless for the treatment of throat infection."

"No, Sir," replied Mr. Key. "I am advised that lozenges of this strength are quite effective.

Glue Imports.—A statement of policy regarding importation of glue was given by the the Board of Trade at the request of Mr. Erroll.

Licences to import glue and gelatine were granted freely, said the Parliamentary Secretary. The quantities licensed for import during the past three months showed a marked increase on figures for the previous months. Actual arrivals in the United Kingdom, however, had not so far been large.

Asked by Mr. Erroll why he was insisting on exporting glue at low prices and encouraging the importation of glue at high prices, he undertook to look into the matter.

Cement and Ancillary Industries. — The report of the committee appointed last December by the Minister of Works to inquire into the financial structure of the cement and ancillary industries will be presented early in January, when consideration will be given to its publication, Mr. Tomlinson stated in reply to Mr. Piratin.

Research departments of two Canadian firms claim that the melting time of ore and scrap in open hearth steel production can be reduced to one-fifth of present requirements by the use of oxygen.

Personal Notes

MR. R. J. BAINES, until recently a member of the London staff of Newton Chambers & Co., Ltd., has joined the London office staff of Henry Balfour & Co., Ltd., as a technical representative.

DR. H. W. KEENAN, chief chemist to the British Anti-Fouling Composition & Paint Co., Ltd., who is well known as president of the Oil & Colour Chemists' Association, will become manager of the technical sales service of Beck, Koller & Co. (England), Ltd., on January 1.

DR. ROBERT R. WILLIAMS, director of research of the Research Corporation, New York, has been awarded the 1946 Perkin Medal of the American Section of the Society of Chemical Industry for his outstanding accomplishments in fundamental research on vitamin B_1.

MR. A. BRADBURY, who has been in charge of the chemicals sales department of the Staveley Coal & Iron Co., Ltd., since its formation, has been appointed to the newly-created post of assistant commercial manager, and Mr. A. Slater has been appointed manager of the chemicals sales department.

MR. A. E. SYLVESTER, governor of the Gas Light & Coke Company, is relinquishing his office as governor at the end of the year on medical advice following a recent operation. He will continue as a director. The director have elected MR. MICHAEL MILNE-WATSON, son of the late Sir David Milne-Watson, to be governor, and Mr. F. M. BIRKS as deputy governor in place of Mr Henry Woodall, whose retirement was recently announced.

Obituary

PROFESSOR PAUL LANGEVIN, whose death at the age of 74 occurred in Paris last week, rendered great services to science as a physicist. He entered the Ecole de Physique et de Chimie Industrielle at the age of 16 and after studying and working elsewhere took his D.Sc. in 1902. He succeeded Pierre Curie in the School of Physics and Chemistry, of which he became director in 1925.

Seaweed processing plants have been established in British Columbia. One firm is to manufacture mineral salt tablets for human use and cattle food conditioning, using two varieties of kelp; another is producing agar, and a third is interested in production of alginic acid for moulded products and as a textile material.

Home News Items

Seven more Welsh steel sheet mills will be opened early in the New Year—four at Neath and three at Llanelly. They include the sheet steel mills at the Melyn works, which have been idle since 1941, now taken over by the Neath Sheet Steel and Galvanising Company.

A change of address is announced by the British Tar Confederation and the Coal Tar Research Association, who will shortly be moving to Gas Industry House, 1, Grosvenor Place, London, S.W.1. (Tel. SLOane 6119). All communications should now be sent to the new address.

The Paint Marketing Council has issued a statement pointing out that Great Britain's recent purchase of Argentine oilseed products, including 100,000 tons of linseed oil spread over next year, is unlikely to bring about any increase in paint supplies in this country. The oil will be allocated to the linseed oil consuming industries, and the paint industry will receive its share as the leading consumer.

U.K. exports in November remained at the same volume as the previous month, but they went up in value by £1,200,000 to £92,100,000, which exceeded the July peak by £200,000. Smaller imports of food and drink reduced the figure for total imports by £3,100,000 to £124,300,000 compared with October, but still left it higher than in any earlier post-war month in terms of both value and volume.

The heavy chemical plant section of Cannon Iron Foundries, Ltd., is producing at a far greater rate than at any time in the company's history, according to a statement made by Mr. A. F. Oatley, chairman and joint managing director, speaking at the recent annual meeting. He said plans are in hand for further extensions in this section where market demand, especially export, is greatly in excess of present production capacity and is likely to remain so for a long period.

The Charles Brotherton Chemical Engineering Laboratory at Leeds University was officially opened on December 12 by Mr. George Brotherton-Ratcliffe, in the absence, through illness, of Mr. Charles Brotherton. The Vice-Chancellor, Mr. B. Mouat Jones, explained that the premises would be used temporarily until permits were granted for the building of the laboratory for which, in 1945, Mr. Brotherton had given £55,000. Even so, the University was now in a position to go ahead with the proper training of chemical engineers.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Mortgages and Charges

(*Note.*—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

FROME CHEMICAL CO., LTD. (M., 28/12/46.) November 22, charge to Westminster Bank, Ltd., securing all moneys due or to become due to the bank; charged on land and premises at Christchurch Street East, Frome, including fixtures. *Nil. October 19, 1946.

McCLURE YOUNG & CO., LTD., London, W., manufacturers of disinfectants. (M., 28/12/46.) November 21, £4500 (not ex.) Land Registry charge to Lloyds Bank, Ltd.; charged on 159 Bollo Bridge Road, Acton. *Nil. June 13, 1946.

Satisfaction

JOHN PRENTICE (LONDON), LTD., London, W.C., manufacturers of chemical products. (M.S., 28/12/46.) Satisfaction November 29 of debentures registered March 7, 1945, to the extent of £1,500.

The nominal capital of **Phensic International Products, Ltd.,** 68 Pall Mall, London, S.W.1, has been increased, beyond the registered capital of £100, by £2400, in £1 shares.

Chemical and Allied Stocks and Shares

ALTHOUGH business in stock markets has contracted owing to holiday influences, firmness has been maintained, helped by a better tendency in British Funds. Home rails strengthened, but the prior charge stocks remained below their "take-over" levels. Industrial shares claimed chief attention, with buying again centred mainly on shares in industries outside the Government's nationalisation programme. Yield considerations again attracted demand to iron and steels, and chemicals and kindred shares also remained in favour.

Imperial Chemical at 45s. 1¼d. held virtually all their recent good advance, it being pointed out that, in comparison with the return on many other leading industrial shares, they still offer a not unattractive yield. Moreover, it is generally assumed that sooner or later the dividend, which has been limited to 8 per cent for some years, will be less conservative. B. Laporte were 103s. 6d., Lever & Unilever 52s. 6d., and Turner & Newall firmer at 88s. 6d. Fisons attracted more attention and moved up to 64s. 3d., while British Drug Houses at 61s. 3d. further improved on expected benefits from the abolition of E.P.T. and the probable scope for fresh expansion in export trade. Greeff-Chemicals 5s. ordinary showed firmness at 13s. 6d., and Borax Consolidated, on higher dividend hopes, have been well maintained at 48s. 3d. British Aluminium were steady at 45s. 9d., while in other directions, British Glues & Chemicals 4s. ordinary rose further to 17s. 9d. At 55s. British Match continued firm, W. J. Bush were again quoted at 90s. but remained tightly held with few shares available in the market. British Plaster Board showed firmness at 34s., with Associated Cement 68s. 9d.

Reflecting hopes that the upward trend in iron and steel output will be continued next year with benefits to earnings, iron and steel shares attracted rather more attention, prices showing moderate gains. United Steel were 26s. 9d., South Durham Steel 27s. 9d., and Dorman Long 28s. Whitehead Iron advanced further to 103s. 9d. In other directions, Babcock & Wilcox were good at 70s. 9d., John Summers rose to 36s. 6d., and Allied Ironfounders were 64s. Guest Keen have been prominent at 48s. 6d. Tube Investments touched £7¼, and Stewarts & Lloyds were 56s. 6d.

Bradford Dyers at 26s. 3d., Bleachers 14s. 6d., and Calico Printers 24s. 3d have been steady, while in other directions, Courtaulds continued active around 54s. 3d., with British Celanese higher at 33s. German potash bonds became steadier after their recent fall.

Boots Drug were little changed at 63s 9d., Beechams deferred 28s., Sangers 34s 3d., Griffiths Hughes 62s. 7½d., and Timothy Whites 49s. 6d. Paint shares held the greater part of recent gains, although they were less active, Goodlass Wall being 22s. 10½d., and International Paint £7¼, with Pinchin Johnson 51s. 6d. Linoleum shares were also less firm on the latest news regarding linseed oil supplies, Nairn & Greenwich being 85s., and Barry & Staines 59s. 3d. De La Rue were £13⅜, and British Industrial Plastics 2s. shares 8s. There was a better tendency in Triplex Safety Glass 10s. ordinary at 38s. 6d. The latter offer only a moderate yield on the basis of last year's reduced dividend, but there is a strong balance-sheet position, and it is generally assumed that in time dividends are likely to regain pre-war levels. Oil shares remained dull, Shell further easing to 9s., and Burmah Oil to 65s. Canadian Eagle Oil showed activity but failed to hold best levels.

Prices of British Chemical Products

THE approach of the end of the year has not witnessed any important changes in the London industrial chemicals market, although an upward revision of prices in some directions is considered more than a possibility. A strong demand has persisted in most sections and the supply position generally shows no sign of an immediate improvement. The past week has been dominated by the Christmas holiday and activity has been restricted accordingly.

MANCHESTER.—Holiday influences have had an unmistakable effect on trading conditions on the Manchester chemical market during the past week, not only in respect of new bookings, but also from the point of view of contract deliveries. The latter have been brought virtually to a standstill owing to the stoppages at textile mills and other consuming works, the majority of which are closed down for longer periods than usual for Christmas. A steady resumption is looked for as soon as the holidays are out of the way and also active fresh buying for home use as well as for shipment.

Price Changes

Rises: Glycerine, oxalic acid (Manchester), salicylic acid (Manchester), sulphuric acid.

General Chemicals

Acetic Acid.—Maximum prices per ton: 80% technical, 1 ton, £47 10s.; 80% pure, 1 ton, £49 10s.; commercial glacial, 1 ton, £59; delivered buyers' premises in returnable barrels: £4 10s. per ton extra if packed and delivered in glass.

Acetone.—Maximum prices per ton, 50 tons and over, £65; 10/50 tons, £65 10s.; 5/10 tons, £66; 1/5 tons, £66 10s.; single drums, £67 10s.; delivered buyers' premises in returnable drums or other containers having a capacity of not less than 45 gallons each. For delivery in non-returnable containers of 40/50 gallons, the maximum prices are £3 per ton higher. Deliveries of less than 10 gallons free from price control.

Alum.—Loose lump, £16 per ton, f.o.r. MANCHESTER: £16 to £16 10s.

Aluminium Sulphate.—Ex works, £11 10s. per ton d/d. MANCHESTER: £11 10s.

Ammonia, Anhydrous.—1s. 9d. to 2s. 3d. per lb.

Ammonium Bicarbonate.—MANCHESTER: £40 per ton d/d.

Ammonium Carbonate.—£42 per ton d/d in 5 cwt. casks. MANCHESTER: Powder, £43 d/d.

Ammonium Chloride.—Grey galvanising, £22 10s. per ton, in casks, ex wharf. Fine white 98%, £19 10s. per ton. See also Salammoniac.

Ammonium Persulphate.—MANCHESTER: £5 per cwt. d/d.

Antimony Oxide.—£120 to £123 per ton.

Arsenic.—Per ton, 99/100%, £38 6s. 3d. to £41 6s. 3d., according to quality, ex-store.

Barium Carbonate.—Precip., 4-ton lots, £19 per ton d/d; 2-ton lots, £19 5s. per ton. bag packing, ex works.

Barium Chloride.—98/100% prime white crystals, 4-ton lots, £19 10s. per ton, bag packing, ex works.

Barium Sulphate (Dry Blanc Fixe).—Precip., 4-ton lots, £18 15s. per ton d/d; 2-ton lots, £19 10s. per ton.

Bleaching Powder.—Spot, 35/37%, £11 to £11 10s. per ton in casks, special terms for contract.

Borax.—Per ton for ton lots, in free 1-cwt. bags, carriage paid: Commercial, granulated, £30; crystals, £31; powdered, £31 10s.; extra fine powder, £32 10s. B.P., crystals, £39; powdered, £39 10s.; extra fine, £40 10s. Borax glass, per ton in free 1-cwt. waterproof paper-lined bags, for home trade only, carriage paid: lump, £77; powdered, £78.

Boric Acid.—Per ton for ton lots in free 1-cwt. bags, carriage paid: Commercial, granulated, £52; crystals, £53; powdered, £54; extra fine powder, £56. B.P., crystals, £61; powder, £62; extra fine, £64.

Calcium Bisulphide.—£6 10s. to £7 10s. per ton f.o.r. London.

Calcium Chloride.—70/72% solid, £5 15s. per ton, ex store.

Charcoal, Lump.—£22 per ton, ex wharf. Granulated, £27 per ton.

Chlorine, Liquid.—£23 per ton, d/d in 16/17 cwt. drums (3-drum lots).

Chrometan.—Crystals, 5½d. per lb.

Chromic Acid.—1s. 10d. to 1s. 11d. per lb., less 2½%, d/d U.K.

Citric Acid.—Controlled prices per lb., d/d buyers' premises. For 5 cwt. or over, anhydrous, 1s. 6¾d., other, 1s. 5d.; 1 to 5 cwt., anhydrous, 1s. 9d., other, 1s. 7d. Higher prices for smaller quantities.

Copper Carbonate.—MANCHESTER: £8 15s. per cwt. d/d.

Copper Oxide.—Black, powdered, about 1s. 4½d. per lb.

Copper Sulphate.—£37 10s. per ton f.o.b., less 2%, in 2 cwt. bags.

Cream of Tartar.—100 per cent., per cwt., from £12 14s. 6d. for 10-cwt. lots to £14 1s. per cwt. lots, d/d. Less than 1 cwt., 2s. 5½d. to 2s. 7½d. per lb. d/d.

Formaldehyde.—£27 to £28 10s. per ton in casks, according to quantity, d/d. MANCHESTER: £28.

Formic Acid.—85%, £54 per ton for ton lots, carriage paid.

Glycerine.—Chemically pure, double distilled 1260 s.g., £6 per cwt. Refined pale straw industrial, 5s. per cwt. less than chemically pure.

Hexamine.—Technical grade for commercial purposes, about 1s. 4d. per lb.; free-running crystals are quoted at 2s. 1d. to 2s. 3d. per lb.; carriage paid for bulk lots.

Hydrochloric Acid.—Spot, 7s. 6d. to 8s. 9d. per carboy d/d, according to purity, strength and locality.

Hydrofluoric Acid.—59/60%, about 1s. to 1s. 2d. per lb.

Hydrogen Peroxide.—11d. per lb. d/d, carboys extra and returnable.

Iodine.—Resublimed B.P., 10s. 4d. to 14s. 6d. per lb., according to quantity.

Lactic Acid.—Pale tech., £60 per ton; dark tech., £53 per ton ex works; barrels returnable.

Lead Acetate.—White, 70s. to 75s. per cwt., according to quantity.

Lead Nitrate.—About £70 per ton d/d in casks. MANCHESTER: £70 to £72.

Lead, Red.—Basic prices per ton: Genuine dry red lead, £71; orange lead, £83. Ground in oil: Red, £92; orange, £104. Ready-mixed lead paint: Red, £99; orange, £111.

Lead, White.—Dry English, in 8-cwt. casks, £83 per ton. Ground in oil, English, in 5-cwt. casks, £102 per ton.

Litharge.—£68 10s. to £71 per ton, according to quantity.

Lithium Carbonate.—7s. 9d. per lb. net.

Magnesite.—Calcined, in bags, ex works, £36 per ton.

Magnesium Chloride.—Solid (ex wharf), £27 10s. per ton.

Magnesium Sulphate.—£12 to £14 per ton.

Mercuric Chloride.—Per lb., for 2-cwt lots, 9s. 1d.; smaller quantities dearer.

Mercurous Chloride.—10s. 1d. to 10s. 7d. per lb., according to quantity.

Mercury Sulphide, Red.—Per lb., from 10s. 3d. for ton lots and over to 10s. 7d. for lots of 7 to under 30 lb.

Methylated Spirit.—Industrial 66° O.P. 100 gals., 3s. per gal.; pyridinised 64° O.P. 100 gal., 3s. 1d. per gal.

Nitric Acid.—£24 to £26 per ton, ex works.

Oxalic Acid.—£100 to £105 per ton in ton lots packed in free 5-cwt. casks. MANCHESTER: £5 to £5 5s. per cwt.

Paraffin Wax.—Nominal.

Phosphorus.—Red, 3s. per lb. d/d; yellow, 1s. 10d. per lb. d/d.

Potash, Caustic.—Solid, £65 10s. per ton for 1-ton lots; flake, £76 per ton for 1-ton lots. Liquid, d/d, nominal.

Potassium Bichromate.—Crystals and granular, 7⅞d. per lb.; ground, 8⅛d. per lb., for not less than 6 cwt.; 1-cwt. lots, ¼d. per lb. extra.

Potassium Carbonate.—Calcined, 98/100%, £57 per ton for 5-ton lots, £57 10s. per ton for 1 to 5-ton lots, all ex store; hydrated, £51 per ton for 5-ton lots, £51 10s. for 1 to 5-ton lots.

Potassium Chlorate.—Imported powder and crystals, nominal.

Potassium Iodide.—B.P., 8s. 8d. to 12s. per lb., according to quantity.

Potassium Nitrate.—Small granular crystals, 76s. per cwt. ex store, according to quantity.

Potassium Permanganate.—B.P., 1s. 8½d. per lb. for 1-cwt. lots; for 3 cwt. and upwards, 1s. 8d. per lb.; technical, £7 14s. 3d. to £8 6s. 3d. per cwt., according to quantity d/d.

Potassium Prussiate.—Yellow, nominal.

Salammoniac.—First lump, spot, £48 per ton; dog-tooth crystals, £50 per ton; medium, £48 10s. per ton; fine white crystals, £19 10s. per ton, in casks, ex store.

Salicylic Acid.—MANCHESTER: 1s. 10d. to 2s. 2d. per lb. d/d.

Soda, Caustic. — Solid 76/77%; spot, £16 7s. 6d. per ton d/d.

Sodium Acetate.—£42 per ton, ex wharf.

Sodium Bicarbonate.—Refined, spot, £11 per ton, in bags.

Sodium Bichromate.—Crystals, cake and powder, 6½d. per lb.; anhydrous, 7½d. per lb., net, d/d U.K. in 7-8 cwt. casks.

Sodium Bisulphite. — Powder, 60/62%, £19 10s. per ton d/d in 2-ton lots for home trade.

Sodium Carbonate Monohydrate.—£25 per ton d/d in minimum ton lots in 2 cwt. free bags.

Sodium Chlorate.—£45 to £47 per ton.

Sodium Hyposulphite.—Pea crystals 19s. per cwt. (ton lots); commercial, 1-ton lots, £17 per ton carriage paid. Packing free.

Sodium Iodide.—B.P., for not less than 28 lb., 10s. 2d. per lb.

Sodium Metaphosphate (Calgon).—11d. per lb. d/d.

Sodium Metasilicate.—£16 10s. per ton, d/d U.K. in ton lots.

Sodium Nitrite.—£23 per ton.

Sodium Percarbonate.—12½% available oxygen, £7 per cwt.

Sodium Phosphate.—Di-sodium, £25 per ton d/d for ton lots. Tri-sodium, £27 10s. per ton d/d for ton lots (crystalline).

Sodium Prussiate.—9d. to 9½d. per lb. ex store.

Sodium Silicate.—£6 to £11 per ton.

Sodium Sulphate (Glauber Salt).—£5 5s. per ton d/d.

Sodium Sulphate (Salt Cake).—Unground. Spot £4 11s. per ton d/d station in bulk. MANCHESTER: £4 12s. 6d. to £4 15s. per ton d/d station.

Sodium Sulphide. — Solid, 60/62%, spot, £20 2s. 6d. per ton, d/d, in drums; crystals, 30/32%, £13 7s. 6d. per ton, d/d, in casks.

Sodium Sulphite.—Anhydrous, £29 10s. per ton; pea crystals, £20 10s. per ton d/d station in kegs; commercial, £12 to £14 per ton d/d station in bags.

Sulphur.—Per ton for 4 tons or more, ground, £14 5s. to £16 10s., according to fineness.

Sulphuric Acid.—168° Tw., £6 2s. 8d. to £7 2s. 8d. per ton; 140° Tw., arsenic-free, £4 15s. per ton;: 140° Tw., arsenious, £4 7s. 6d. per ton. Quotations naked at sellers' works.

Tartaric Acid.—Per cwt., for 10 cwt. or more, £15 8s.; 5 to 10 cwt., £15 9s. 6d.; 2 to 5 cwt., £15 11s.; 1 to 2 cwt., £15 13s. Less than 1 cwt., 3s. 1d. to 3s. 3d. per lb. d/d, according to quantity.

Tin Oxide.—1 cwt. lots d/d £25 10s.

Zinc Oxide.—Maximum prices per ton for 2-ton lots, d/d; white seal, £58 10s.; green seal, £57 10s.; red seal, £56.

Zinc Sulphate.—Tech., £25 per ton, carriage paid.

Rubber Chemicals

Antimony Sulphide.—Golden, 1s. 8½d. to 2s. 7½d. per lb. Crimson, 2s. 7½d. to 3s. per lb.

Arsenic Sulphide.—Yellow, 1s. 9d. per lb.

Barytes.—Best white bleached, £8 8s. 6d. per ton.

Cadmium Sulphide.—6s. to 6s. 6d. per lb.

Carbon Bisulphide.—£37 to £41 per ton, according to quality, in free returnable drums.

Carbon Black.—6d. to 8d. per lb., according to packing.

Carbon Tetrachloride.—£48 to £51 per ton, according to quantity.

Chromium Oxide.—Green, 2s. per lb.

India-rubber Substitutes.—White, 10 5/16d to 1s. 5¾d. per lb.; dark, 10¼d. to 1s. per lb.

Lithopone.—30%, £28 2s. 6d. per ton.

Mineral Black.—£7 10s. to £10 per ton.

Mineral Rubber, "Rupron."—£20 per ton.

Sulphur Chloride.—7d. per lb.

Vegetable Lamp Black.—£49 per ton.

Vermilion.—Pale or deep, 15s. 6d. per lb. for 7-lb. lots.

Nitrogen Fertilisers

Ammonium Phosphate.—Imported material, 11% nitrogen, 48% phosphoric acid, per ton in 6-ton lots, d/d farmer's nearest station, in December £20 4s. 6d., rising by 2s. 6d. per ton per month to March, 1947.

Ammonium Sulphate.—Per ton in 6-ton lots, d/d farmer's nearest station, in December £9 18s. 6d., rising by 1s. 6d., per ton per month to March, 1947.

Calcium Cyanamide.—Nominal; supplies very scanty.

Concentrated Fertilisers.—Per ton d/d farmer's nearest station, I.C.I. No. 1 grade, where available, £14 18s. 6d.

"Nitro Chalk."—£9 14s. per ton in 6-ton lots, d/d farmer's nearest station.

Sodium Nitrate.—Chilean super-refined for 6-ton lots d/d nearest station, £17 5s. per ton; granulated, over 98%, £16 per ton.

Coal Tar Products

Benzol.—Per gal. ex works: 90's, 2s. 6d.; pure, 2s. 8½d.; nitration grade, 2s. 10½d.

Carbolic Acid.—Crystals, 11½d. per lb. Crude, 60's, 4s. 3d. MANCHESTER: Crystals, 9½d. to 11½d. per lb., d/d; crude, 4s. 3d., naked, at works.

Creosote.—Home trade, 5½d. to 8d. per gal., according to quality, f.o.r. maker's works. MANCHESTER, 6½d. to 9½d. per gal.

Cresylic Acid.—Pale, 97%, 3s. 6d. per gal.; 99%, 4s. 2d.; 99.5/100%, 4s. 4d. American, duty free, 4s. 2d., naked at works. MANCHESTER: Pale, 99/100%, 4s. 4d. per gal.

Naphtha.—Solvent, 90/160°, 2s. 10d. per gal. for 1000-gal. lots; heavy, 90/190°, 2s. 4d. per gal. for 1000-gal. lots, d/d. Drums extra; higher prices for smaller lots. Controlled prices.

Naphthalene.—Crude, ton lots, in sellers' bags, £7 2s. 6d. to £10 per ton, according to m.p.; hot-pressed, £11 10s. to £12 10s. per ton, in bulk ex works; purified crystals, £25 15s. to £28 15s. per ton. Controlled prices.

Pitch.—Medium, soft, home trade, 75s. per ton f.o.r. suppliers' works; export trade, 120s. per ton f.o.b. suppliers' port. MANCHESTER: 77s. 6d. f.o.r.

Pyridine.—90/140°, 18s. per gal.; 90/160°, 14s. MANCHESTER: 14s. 6d. to 18s. 6d. per gal.

Toluol.—Pure, 3s. 2½d. per gal.; 90's, 2s. 4d. per gal. MANCHESTER: Pure, 3s. 2½d. per gal. naked.

Xylol.—For 1000-gal. lots, 3s. 3½d. to 3s. 6d. per gal., according to grade, d/d.

Wood Distillation Products

Calcium Acetate.—Brown, £15 per ton; grey, £22.

Methyl Acetone.—40/50%, £56 to £60 per ton.

Wood Creosote.—Unrefined, from 3s. 6d. per gal., according to boiling range.

Wood Naphtha.—Miscible, 4s. 6d. to 5s. 6d. per gal.; solvent, 5s. 6d. to 6s. 6d. per gal.

Wood Tar.—£6 to £10 per ton.

Intermediates and Dyes (Prices Nominal

m-**Cresol** 98/100%.—Nominal.

o-**Cresol** 30/31° C.—Nominal.

p-**Cresol** 34/35° C.—Nominal.

Dichloraniline.—2s. 8½d. per lb.

Dinitrobenzene.—8½d. per lb.

Dinitrotoluene.—48/50° C., 9½d. per lb; 66/68° C., 1s.

p-**Nitraniline.**—2s. 5d. per lb.

Nitrobenzene.—Spot, 5½d. per lb. in 90-gal. drums, drums extra, 1-ton lots d/d buyer's works.

Nitronaphthalene.—1s. 2d. per lb.; P.G., 1s. 0½d. per lb.

o-**Toluidine.**—1s. per lb., in 8/10 cwt. drums, drums extra.

p-**Toluidine.**—2s. 2d. per lb., in casks.

m-**Xylidine Acetate.**—4s. 5d. per lb., 100%.

Latest Oil Prices

LONDON.—December 23. For the period ending December 28 (February 1, 1947, for refined oils), per ton, naked, ex mill, works or refinery, and subject to additional charges according to package; LINSEED OIL, crude, £135. RAPESEED OIL, crude, £91. COTTONSEED OIL, crude, £80; washed, £84. COCONUT OIL, crude, £80; refined deodorised, £84; refined hardened deodorised, £88. PALM KERNEL OIL, crude, £79; refined deodorised, £84; refined hardened deodorised, £88. PALM OIL (per ton c.i.f.), in returnable casks, £58 10s.; in drums on loan, £58; in bulk, £57. GROUNDNUT OIL, crude, £56 10s.; refined deodorised, £86; refined hardened deodorised, £90. WHALE OIL, refined hardened, 42 deg., £89; refined hardened, 46/48 deg., £90. ACID OILS. Groundnut, £55; soya, £53; coconut and palm-kernel, £58 10s. ROSIN: Wood, 32s. to 45s.; gum, 44s. to 54s. per cwt., ex store, according to grade. TURPENTINE, American, 87s. per cwt. in drums or barrels, as imported (controlled price).

Inventions in the Chemical Industry

The following information is prepared from the Official Patents Journal. Printed copies of specifications accepted may be obtained from the Patent Office, Southampton Buildings, London, W.C.2., at 1s. each. Numbers given under "Applications for Patents" are for reference in all correspondence up to acceptance of the complete specification

Applications for Patents

Azomethine dyes.—General Aniline & Film Corporation. 34568.

Merocyanines.—General Aniline & Film Corporation. 34938.

Dyestuffs.—General Aniline & Film Corporation. 34939.

Heating mixtures.—P. A. H. Goldsmith, and Heaters, Ltd. 34672.

Preparation of silica.—D. E. B. Greensmith, C. Shaw, and W. E. Smith. 34581.

Phthalocyanine derivatives.—N. H. Haddock, C. Wood, and I.C.I., Ltd. 34640.

Magnesium hydroxide.—D. V. N. Hardy, and D. G. Grant. 34791.

Cracking hydrocarbons.—Hercules Powder Co. 34324-5.

Spirit rectifying apparatus.—W. W. Hutcheson, and W. C. Mason. 34921.

Gasification of carbonaceous material.—C. P. Jenkyns. 34257.

Nickel-chromium steels.—W. Jessop & Sons, Ltd., D. A. Oliver, and G. T. Harris. 34621.

Saponification products.—Jiri Schicht A/S. 34464.

Alky sulphonates.—Jiri Schicht, A/S. 34465.

Sterols.—Jiri Schicht, A/S. 34467.

Fat stabilisators.—Jiri Schicht, A/S. 34468.

Fatty acids.—Jiri Schicht, A/S. 34469.

Enriching chrome ores.—R. Job. 34720.

Rubber calendering device.—F. Landau, J. G. Norberg, and Allmanna Svenska Elektriska A/B. 34364.

Production of wire, etc., from powdered material.—Mallory Metallurgical Products, Ltd., and C. C. Hyde. 34902.

Phenanthridine derivatives.—May & Baker, Ltd., and H. J. Barber. 34582.

Corrosion inhibitors.—Merck & Co., Inc. 34372.

Unsaturated alcohols.—N.V. de Bataafsche Petroleum Maatschappij. 34296.

Anthracene derivatives.—Neville Co. 34677.

Laminated materials.—Plaswood Corporation. 34432.

Abrasive coated material.—W. F. Procter, G. W. Webb, and K. B. Pearce. 34810.

Polarographic analysis.—J. E. B. Randles, and L. Airey. 34891.

Compounding of rubber.—Redfern's Rubber Works, Ltd., and F. E. Brown. 34543.

Fibrous products.—G. Slayter. 34433.

Anthraquinone dyestuffs.—F. H. Slinger, W. W. Tatum, and I.C.I., Ltd. 34641.

Organo-silicon compounds.—F. J. Sowa. 31600-1.

Condensation polymers.—Wingfoot Corporation. 34565.

Carboxylic acids.—Winthrop Chemical Co., Inc. 34678.

Vapour burners.—G. W. Zimbelman. 34932.

Complete Specifications Open to Public Inspection

Evaporator plants.—Gotaverken A/B. May 19, 1945. 20618/45.

Alkamine esters of 1-cyclohexylpyrrole-3, 4-dicarboxylic acids.—American Cyanamid Co. July 31, 1943. 12006/44.

Production of polymerised halogen substituted ethylene compositions.—American Cyanamid Co. May 26, 1945. 15326-7/46.

Process for the fermentative treatment of vegetable materials, in particular of cereals and their waste products. Bouckova, O., and Kriz, A. April 15, 1942. 32175/46.

Automatic control of the rate of ion-exchange in the purification of water or the treatment of salt solutions.—Carbonisation et Charbons Actifs. Jan. 10, 1945. 31478/46.

Manufacture of disazo dyestuffs.—Ciba, Ltd. May 25, 1945. 15223-4/46.

Manufacture of organo-siloxanes.—Corning Glass Works. March 30, 1943. 8281/44.

Polymerisation of unsaturated compounds.—E.I. Du Pont de Nemours & Co. May 22, 1945. 15485/46.

Polymerisation and interpolmerisation of ethylene.—E.I. Du Pont de Nemours & Co. May 22, 1945. 15486/46.

Abrasive compositions.—Fish-Schurman Corporation. May 26, 1943. 8843/44.

Vapour generators.—Foster Wheeler, Ltd. May 24, 1945. 15514/46.

Interpolymer of esters of α-haloacrylic acid polychorostyrene.—General Aniline & Film Corporation. May 24, 1945. 11562/46.

Vinyl-synthetic rubber compositions and synthetic rubber.—B. F. Goodrich Co. Aug. 12, 1944. 32205/46.

Pest control compositions.—I.C.I., Ltd. June 2, 1943. 14911/44.

Process for washing or chemically cleaning porous spongy materials made of regenerated cellulose or cellulose derivatives.—Kooperativa Forbundet Forening U.P.A. April 27, 1945. 12876/46.

Method for the continuous production of soap.—L'Oreal Soc. Anon. Aug. 27, 1943. 21228/46.

Styrene fractionation.—Lummus Co. May 5, 1942. 7421/43.

Refractory metal composition.—Mallory Metallurgical Products, Ltd. May 23, 1945. 10180/46.

Chemical manufacture.—Mathieson Alkali Works. May 24, 1945. 6866/46.

Process for carrying out catalytic reactions in the gas phase.—N.V. de Bataafsche

Petroleum Maatschappij. July 27, 1944. 31639/46.

Hydrocarbon treatment.—N.V. Internationale Hydrogeneeringsoctrooien Maatschappij. May 26, 1945. 12402/46.

Complete Specifications Accepted

Hot rolling of metals and alloys.—N. E. Allott. Sept. 1, 1944. 582,293.

Concentration of non-sulphide iron ores. —American Cyanamid Co. April 5, 1943. 582,450.

Production of polystyrene.—A. Boake Roberts & Co., Ltd., and B. T. D. Sully. July 19, 1943. 582,327.

Creep resistant alloys.—British Driver-Harris Co., Ltd. (Driver-Harris Co.) June 24, 1943. 582,417.

Glass compositions.—British Thomson-Houston Co., Ltd., and J. E. Stanworth. June 23, 1944. 582,353.

Solidifying normally liquid hydrocarbons. —D. M. Clark. (Safety Fuel, Inc.) Feb. 14, 1944. 582,327.

Manufacture of articles made from cellulose acetate.—Courtaulds, Ltd., C. Diamond, and A. Hill. Aug. 29, 1944. 582,284.

Production of solid and semi-solid polymers and interpolymers of ethylene.—I.C.I., Ltd. Jan. 19, 1943. 582,334.

Production of polymeric materials.—I.C.I., Ltd. May 24, 1943. 582,348.

Passivation of zinc and cadmium surfaces including electro-galvanised, galvanised zinc sprayed, zinc plated and cadmium plated surfaces.—International Corrodeless, Ltd., and R. W. Taylor. Oct. 3, 1944. 582,386.

Production of anhydrous magnesium chloride.—Magnesium Elektron, Ltd., and J. A. Dukes. Jan. 11, 1944. 582,332-3.

Production of anhydrous magnesium chloride. Magnesium Elektron, Ltd., S. J Fletcher, and A. L. Hock. Sept. 7, 1944. 582,357.

Vulcanising of synthetic rubber.—Monsanto Chemical Co. Sept. 12, 1943. 582,305.

Manufacture of synthetic resins.—P. H. Rhodes. March 17, 1944. 582,448.

Dehydrogenation of hydrocarbons.—Shell Development Co. March 16, 1942. 582,416.

Catalytic processes.—Standard Oil Development Co. July 24, 1941. 582,414.

Hydration of olefins.—Standard Oil Development Co. Aug. 6, 1942. 582,418.

Electrowinning of manganese.—A. H. Stevens. (Electro Manganese Corporation.) April 11, 1944. 682,451.

Apparatus for converting molten glass and the like to fine fibres.—A. P. Thurston. (Owens-Corning Fiberglas Corporation.) June 1, 1944. 582,472.

Utilising waste heat from internal-combustion engines.—W. W. Triggs. (Maxim Silencer Co.) June 15, 1945. 582,399.

Dithiofuroates.—Wingfoot Corporation. Jan. 5, 1944. 582,316.

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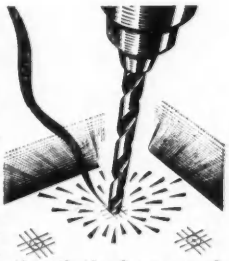

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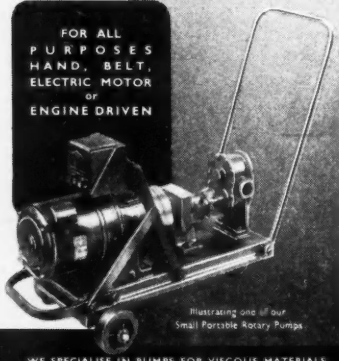

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